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ABSTRACT

This dissertation details a plan for integrating multimedia technology into the learning environment at Northern Maine Technical College (NMTC), considering available hardware and software, the implications for campus-based and distance education, and needs for instructional, organizational, and human resource development. A literature review uncovered a wide range of available hardware and software, success stories of multimedia integration at other institutions, and the need for major changes in NMTC's current educational system. Data collection involved both internal and external environmental assessment, and the study included seeking expert feedback at many points in the process and incorporating it into the final plan. Research suggested that multimedia technologies applied to the teacher-centered model of education will achieve only marginal gains in effectiveness and efficiency; the focus of the new educational paradigm is on learning, not teaching. Among other things, a plan for multimedia integration must: allow for regular human resource development programs and secure necessary funds; focus on the knowledge-database, communications, and learning management capabilities of the institution as well as the development of alternative methods of teaching, student assessment, and scheduling of services; explore distance delivery methods; promote regular use of electronic communications; institute a faculty resource center for training; and counter technological obsolescence with a plan for regular equipment amortization and replacement. Appendices provide institution-specific information such as mission statements, vision statements, maps, and lists of consortium members. They also include an equipment and software use inventory, a questionnaire, planning lists, and copies of correspondence. (Contains 8 tables, 4 figures, and 169 references.) (BEW)

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DEVELOPMENT OF A MULTI-YEAR PLAN FOR THE INTEGRATION OF MULTIMEDIA TECHNOLOGY INTO THE LEARNING ENVIRONMENT AT NORTHERN MAINE TECHNICAL COLLEGE

Terrence H. Overlock, Sr.

A major applied research project presented to Programs for Higher
Education in partial fulfillment of the requirements
for the degree of Doctor of Education

Nova Southeastern University

November, 1995

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Although much new technology had been made available recently, little had changed within the learning environment at Northern Maine Technical College (NMTC). The purpose of this project was to develop a plan for integrating multimedia technology into the learning environment.

The research questions posed for this project were (a) what are the current multimedia hardware and software technologies available? (b) what are the implications for campus based learning and distance education networks? and (c) what should be included in a multi-year

action plan for multimedia utilization at NMTC in terms of instructional, organizational, human resource development?

The development problem solving methodology used in this project consisted primarily of data gathering and plan development activities adapted from Collins (1993). The data gathering included an intensive literature review, and an internal and external environmental assessment done to identify issues pertinent to the multimedia use at NMTC.

The planning activity began with a report to the management team, including the major implications and findings of the data gathering activity along with a list of possible options-actions to be taken. Following a trade-offs analysis of the list of possible options-actions by the management team, a draft plan was prepared and distributed to five external experts for review and comment. Their comments were incorporated into the final plan and a project report presented to the NMTC management team and strategic planning committee in support of future institutional planning activities.

Several conclusions were reached including (a) there is a constantly changing variety of multimedia hardware and software available; (b) major changes must occur in the current educational system in order to make it more effective and efficient in meeting the needs of students in a technological society; (c) technological obsolescence is a growing problem and should be controlled with a routine equipment amortization and replacement plan; (d) there are increasing accounts of successful use of multimedia in the learning environment; (e) multimedia technologies applied to the current teacher-centered model of education will achieve only marginal gains in effectiveness and efficiency; (f) the focus of the new learning paradigm will be on learning, not teaching; (g) distance delivery systems are becoming more desirable and cost effective; (h) regular HRD programs, supported by adequate resources, are necessary for successful transition; (i) a plan for multimedia integration must focus on the knowledge-database, communications, and learning management capabilities of the institution; (j) instructional development must focus on greater use of multimedia and development of alternative methods of teaching, student assessment, and scheduling of services; (k) exploration of distance delivery methods should be included in the plan; (l) the plan should promote regular use of electronic communications by all; (m) learning, not teaching, must become the institutional focus; (n) a faculty resource center should be developed to facilitate faculty training; and (o) the HRD program must assess faculty and staff training needs routinely, and provide ongoing support for developing new skills.

Recommendations resulting from this project included (a) the plan should be used to provide a balanced approach in facilitating the changes necessary to accomplish the transition to a technology-based learning environment at NMTC; (b) a regular equipment amortization and replacement plan should be developed to help deal with technological obsolescence; and (c) the resources available for HRD programs in support of this plan should be increased.

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Chapter 1

INTRODUCTION

Nature of the Problem

Although much new technology and training had been made available in the last few years due to successful grant projects, not much had changed within the actual teaching/learning process at Northern Maine Technical College. Although some faculty had begun to explore alternative teaching techniques, several factors (heavy teaching load, lack of training time, lack of up-to-date equipment) had combined to leave the learning environment still primarily teacher centered, classroom and campus based.

Preparing a student body increasingly diverse in educational background for an occupational environment requiring workers to be more team oriented, life-long learning oriented and technologically literate is becoming increasingly difficult within the current NMTC learning environment. However, newer teaching/learning models linked to multimedia technology with an emphasis on application of knowledge hold much promise to assist in more effectively meeting these challenges. Utilization of these methods and technologies will support the fundamental restructuring of the current classroom-based, teacher-centered paradigm to a student-centered, technology-based paradigm.

At NMTC computers are used mostly to teach business applications and help faculty in test preparation, grade management, and so forth. Some computer aided instruction (CAI) is used. Video tapes are used by some to enhance class presentations. Whatever the technology used, its prime function has been to support or enhance the lecture/ discussion teaching method, a teaching technique which research has shown to be the least effective in learning outcomes.

Research indicates that students carry away in their heads and in their notebooks not more than 42% of the content (McLeisch, in Stetson, 1993). Even worse, a week later, students can recall only 17% of the lecture material (Cross, in Stetson, 1993, p. 1). This is coupled with the fact that NMTC's student is becoming increasingly diverse in age, educational background, foundation skills, and gender. Also complicating the situation is the fact that many students travel one or more hours drive time one way and many have part-time or full-time jobs. This increasing diversity has created additional strains on the traditional delivery system and it is hoped that an increased use of new information technologies can be of assistance in meeting the changing needs of today's students.

Purpose of the Project

The purpose of this project was to develop a multi-year plan for the integration of multimedia technology into the learning environment at

NMTC. This was an attempt to develop a plan for change leading to a fundamental restructuring of the teaching/learning process at NMTC utilizing the power of recent advances in educational technology.

The plan was in direct support of current NMTC strategic planning goals and objectives. One of the primary objectives in the current strategic plan is to utilize instructional processes that allow students to achieve at their maximum potential. The fourth assumption in the current plan states: ". . . technology change will require innovation and revision of courses, programs, and support areas. . . . There is strong potential that some instructional programs will employ new technology and course delivery/learning systems in the instructional process" (NMTC, 1994, p. 13). The planning goal addressing this assumption speaks to enhancing college effectiveness by remaining responsive to the technical needs of students, employers and the community. Two short range objectives focus this goal on the use of multimedia in the teaching and learning process at NMTC. They are to (a) develop an implementation plan for the inclusion of multimedia instruction in all instructional areas by January 30, 1995, and (b) provide professional development for faculty in the use of multimedia in the classroom. It is believed that this project will provide a comprehensive planning framework that will facilitate the effective and efficient integration of multimedia into the learning environment at NMTC.

Background and Significance

Northern Maine Technical College

Northern Maine Technical College (NMTC) is one of seven technical colleges within the Maine Technical College System (MTCS) charged with ". . . creating an educated, skilled and adaptable labor force which is responsive to the workplace needs of the state's employers" (NMTC, 1994, p. 6). Appendix A contains the full MTCS Mission Statement. NMTC's mission (see Appendix B) is to "provide training to increase the competence of employed adults, to provide specialized technical training to attract business and industry to locate in Northern Maine and to encourage business and industry now located in the region to expand" (NMTC, p. 8). The MTCS Vision Statement can be found in Appendix C. Appendix D contains the complete NMTC Vision Statement.

Service Area

NMTC's primary service area includes Aroostook County and western New Brunswick, Canada, an area in excess of 6,000 square miles (see Appendix E). However, increased competition for a smaller high school graduate population has forced recruiting efforts to be expanded to a statewide effort. Geographically, Aroostook County makes up 16% of Maine's entire land area. The county is 88% forested (3.8 million acres) with over 2000 lakes, rivers, streams and the 100 mile long

Allagash Wilderness Waterway providing much recreational opportunity. Nearly 330,000 (slightly less than 8%) acres were in farmland in 1987.

The Aroostook County population contains a varied mix of Native Americans, Acadian French, Swedish and New Englanders of varied decent. Migrant populations of Canadian and Hispanic decent vary with the agricultural seasons, but have little influence on the student count at NMTC. Overall the county has shown an 18% decline in population since 1960 (NMRPC, 1992) and the recent closure of Loring Air Force Base will add significantly to this trend as its 6,000 to 7,000 military personnel and their families are reassigned elsewhere. Many of the civilian personnel may also leave because of the specialized nature of their role on the base.

The economic base of the region consists primarily of the agricultural and forest products industries. The forest products industry is remaining static, and the agricultural industry (the primary crop is potatoes) has had two bad seasons in a row adding to the recessionary effects on the local economy. Unemployment continues to hover around the 10% mark and may edge higher as the civilian force at Loring Air Force Base is displaced with the base closure. While manufacturing has declined by 4% since 1980, the services and retail sectors have increased 63% and 48% respectively. In an attempt to counter high unemployment and a recessionary economy, the Maine legislature, in 1993, provided 1.5 million dollars for reskilling displaced workers increasing enrollment in some programs. However, higher paying manufacturing jobs have declined by 20% in the last ten years (NMRPC, 1992) causing many students to have to move upon completion of a program of study in order to find employment in their field.

Programs

Now in its 33rd year of operation (1995-96), NMTC offers 19 full-time associate degree, diploma and certificate programs in the Nursing, Business Technology, and Trade/Technical areas. NMTC programs are accredited regionally through the New England Association of Schools and Colleges (NEAS&C). The campus completed the internal self-study process and underwent the decennial on-site reaccreditation visit in the spring of 1995. In June of 1993, the college achieved national accreditation by the Association of Collegiate Business Schools and Programs for the offering of business programs that culminate in the Associate of Applied Science Degree. The nursing program is accredited by the Maine State Board of Nursing and the National League of Nursing.

Prior to last year, the Nursing program offered a one year Licensed Practical Nurse (LPN) program and a two year Associate Degree Nursing (ADN) program. As a result of the changing health care environment within the state of Maine, only the two year Associate Degree Nurse Program is now available. Graduates from these programs have had a better than 95% pass rate on the state nursing exam, indicating the quality of the program.

The trade and technical department offers programs in automotive technology, computer electronics, diesel hydraulic technology, drafting technology, electrical construction & maintenance, electrical engineering technology, industrial electrical technology, plumbing & heating, residential construction, and sheet metal. All programs offer associate degree, diploma, and certificate options. One program, masonry, offers only a diploma or certificate. Most programs are filled to capacity, and some have a waiting list for entry. This is also a problem in many other programs not only at NMTC, but within the other MTCS institutions also.

The business technology department offers programs in accounting, business administration, computer information systems, office systems, executive administrative assistant, legal administrative assistant, and medical administrative assistant. All lead to an associate degree, diploma or certificate upon completion.

Students

NMTC's student population has remained stable in recent years with approximately 650 full time equivalent students. It is not as ethnically and culturally diverse as may be the case elsewhere in the country. This year enrollments jumped by 15% and the average student age dropped from 29 to 26. This may be the result of Tech Prep articulation agreements with area high schools, but there is no data to substantiate this. The Caucasian and French Acadian cultures are predominant. Small numbers of Native Americans and other ethnic groups are also found. While the student population may not be culturally diverse as some, it is diverse in age, gender and educational background. Many adults returning for retraining find that they need to sharpen some of their foundation learning skills. Others are working either part or full time and some commute over 80 miles one way to class. Comments from instructors concerning the widening range of student abilities, preparation and other competing factors are becoming more common. Fifty-one percent of the current student body meets the definition of nontraditional student and 85% are the first in their family to attend college. NMTC graduates 250 - 260 students annually. Eighty-five percent of them obtain employment within their chosen occupation.

Tech Prep and Title III

NMTC is entering its fifth year (1995) of an ambitious Tech Prep project involving it and over 36 high schools and regional secondary vocational centers (see Appendix F), and has begun an apprenticeship training program sponsored by the MTCS. Currently there are 25 articulation agreements that are operational and another 27 are in progress. The most recently signed agreement creates a 2+2+2 opportunity in agribusiness between Presque Isle High School, NMTC, and the University of Maine at Orono. A major aspect of the Tech Prep project has been the development of a bulletin board system connecting NMTC with the consortium members. This has greatly facilitated communication among the member institutions.

NMTC, along with the other six campuses within the MTCS, is constantly challenged to maintain state-of-the art, up-to-date training for its students that prepare them for the rapidly emerging global society through the development of up-to-date occupational skills. In the fall of 1994 the campus community completed a five year, $2,500,000 Higher Education Act Title III Strengthening Institutions Grant that focused on three areas of concern: student retention, acquisition of up-to-date training equipment, and professional development. New training equipment has been added in nearly every occupational program, and counseling and advising services have been much improved. The major activity of the project included an ambitious professional development program, which involved nearly all faculty and staff in many varied professional development experiences based upon perceived needs. Six faculty needing a baccalaureate degree made significant progress, many completing 50 or more credit hours. Seventeen faculty have completed a masters degree and two others are nearly finished with their masters degree. One person received a doctorate and three are nearing completion. Numerous faculty and staff have traveled to workshops, conventions, seminars, and many have earned specialty certifications. Many were involved in back-to-industry internships during this time also.

Funding

Funding from state revenue's has not kept pace with inflation in recent years. Although state funding support increased by 2.79% in 1991, inflation increased 4.2%. The 1992 state funding support increased by 8.29% exceeding the inflation rate by 5%. However, 1993 and 1994 yielded reductions of 3.25% and 1.4% respectively while inflation increased by 3.3% and 2.5% during the same period. The governor has asked all departments to submit two budgets for the next biennium, one that is essentially flat funded and another that shows "substantial" reductions. This is the result of the current projected state budget shortfall for the next biennium of over $375,000,000.

These trends have resulted in increased costs to students. Since 1989, dorm rental has increased from $700 to $1,100 per semester. In-state tuition has risen from $33 per credit hour to the current $61 per credit hour, and discussions concerning another increase are ongoing. These increases coupled with other new student fees and reductions in financial aid availability are reaching the limit of students' ability to afford a post secondary education. These financial issues have also raised concerns regarding NMTC's ability to maintain the quality of services that have resulted from past successful change initiatives

Other Significant Factors

Doucette (1994) divides the current use of technology in higher education into two categories. The first category includes those uses that help faculty and students do better what they already know how to do, and the second includes those uses that actually transform the way faculty teach and students learn. Most uses of technology fall into the first category. NMTC appears to be no exception. Even though planning documents (NMTC, 1994) attest to the need to be technically current and utilize the latest technology to enhance the learning process, recent additions may not be utilized to their full potential.

Although this lack of innovation or change may not appear to be a problem to many within the educational establishment, others are sounding a warning that the present model of educational delivery must change. "This time, for several reasons higher education may not succeed or even survive if it ignores them" (Burke, 1994, p. 1).

The real challenge to higher education (Burke, 1994) consists of a convergence of three problems: (a) new students, (b) growing public dissatisfaction with higher education, and (c) potential new competitors. The new students are more diverse in gender, culture, and ethnicity. These new students also tend be older and many are attending classes part-time while still working. "The usual classes, where learning depends on attending lectures, do not fit their diverse learning styles or, too often, even their increasingly busy schedules" (Burke, 1994, p. 2). This lack of congruence between diverse learning styles and current methods of delivering the learning experience may be problem for NMTC students also. The new students look at colleges as a consumer would judging price, quality, and convenience (Burke, 1994). As other options become available NMTC students may also take the same view.

Public support of the technical colleges has been very strong with nearly all bond referendums for buildings and equipment receiving strong voter support. However, voter support of the rest of the Maine higher education establishment has declined as was evidenced by the recent rejection of a large bond referendum for the University of Maine System. There are increasing calls for greater cost effectiveness and accountability within the university system and the MTCS may not be far from the same scrutiny. Even though there has historically been strong voter support on bond referendums supporting the technical colleges, state budgetary support has declined over the past few years when compared to inflation. This has led to increased student costs, seriously straining student's ability to afford postsecondary technical education in Maine. "At a time when more education and training will be necessary for the most modest job, decreased access and ability to pay will squeeze out larger and larger numbers of students" (Phelps, 1994, p. 25). Cost effectiveness will continue to be a major issue for some time to come.

Competition from outside the higher education industry is also becoming a greater possibility. Even though higher education currently dominates in granting degrees, serious competition may be posed by the educational potential of the electronic superhighway (Burke, 1994). The potential for this to occur is increased because ". . . the costs of telecommunications are falling whereas the costs of educational space, staffing, and transport are rising, so that over time the economical equation will favor the increased use of telecommunications-based education" (Romiszowski, 1993, p. 4). Delivery of educational services through distributed multimedia has the potential to make the information both portable and assessable (B. Davis, 1993). Accessibility and portability are two main concerns of today's students, and if higher education can not deliver, the information superhighway creates the opportunity for others to do so more economically and with greater flexibility. Issues of funding, accountability, cost effectiveness, access, and equity within higher education are nationwide trends that do not appear to be lessening any time soon. All institutions must be proactive in addressing these issues if they are to be successful in adjusting to the changing needs of society in the information age.

Research Questions

The research questions for this project were (a) what are the current multimedia hardware and software technologies available? (b) what implications do the growing multimedia capabilities hold for campus based learning and distance education networks? and (c) what should be included in a multiyear action plan for multimedia integration in terms of instructional, organizational, and human resource development?

Definition of Terms

The following list of terms connected to the discussion of multimedia technology is adapted from Schaller, 1993 and WVNET, 1993.

Access Time is the time it takes to find, retrieve and display a piece of recorded information.

Adaptive Compression involves compression software that continually analyzes and compensates its algorithm, depending on the type and content of the data and the data storage medium.

Address is the position within a data storage medium at which a given piece of data is recorded.

Algorithm is a plan of the precise sequence of steps needed to accomplish any task.

Aliasing involves noticeable errors in the rendering of any line or surface, due to too-low sampling rate.

Analog refers to the representation of numerical values by physical variables such as voltage, current, etc. Analog devices are characterized by dials and sliding mechanisms.

Analog Video is a video signal that represents an infinite number of smooth changes between given video levels.

Animatics entails a television or animation version of special effects shots used to temporarily fill in scenes in the workprint until the final effects are completed.

ANSI (American National Standards Institute) is a standards-setting nongovernment organization which develops and publishes standards for voluntary use in the United States.

ASCII (American Standard Code for Information Interchange) is a The most popular coding method currently used in small computers for converting letters, numbers, punctuation, and control codes into digital form.

Aspect Ratio concerns the relationship of width and height. When an image is displayed on different screens, the aspect ratio must be kept the same to avoid "stretching" in either the vertical or horizontal direction.

Audio is the term used to refer to sound for multimedia systems. Audio frequencies range from 15 Hz to 20,000 Hz.

Audio Still Frame encompasses the commentary, music or sound effects accompanying a single still image.

Authoring is the preparation of a computer program, often using an "authoring language" or "authoring system" that allows people without formal training in computer programming to prepare applications for computer-based systems.

Authoring Language is a high level computer program, itself often based on a computer programming language like BASIC or Pascal, that facilitates the preparation of computer programs by reducing the number of instructions involved and translating these into a language resembling everyday English.

Authoring System is a collection of authoring programs that allows users without formal computer programming skills to prepare application programs with a good degree of sophistication.

Bandwidth is usually used in context to refer to the amount of data per unit of time that must move from one point to another.

Buffer is a block of memory set aside for temporarily holding data commonly found in computers and peripheral devices.

Byte includes eight bits, the standard amount of information used to define an alphanumeric character. Each bit is a 1 or a 0 of digital information used in a digital code such as ASCII.

CAD/CADD is the acronym for computer-aided design and computer-aided design and drafting.

CAI is computer-assisted (or computer aided) instruction. active videodiscs.

CAM is computer-aided manufacturing.

CAV is constant Angular Velocity. A CAV disc revolves continuously at 1,800 rpm, one revolution per frame, making each frame of the disc addressable - a requirement of interactive videodiscs.

CBT includes computer-based training, tutorials, and simulations consisting of text and possibly graphics, which provide training by means of a mainframe or personal computer. Also known as CAI, CAL or CBI.

CD-Common is a CD format capable of being read on both the Macintosh and IBM machines.

CDI (Compact Disc Interactive) is a CD technology which provides 660 Megabytes of memory. It can carry still graphics and motion video as well as audio. This could mean a possible 7,000 natural still pictures, up to 32,768 colors for user-manipulated graphics and up to 256 colors for full programmed animation.

CD-ROM (Compact Disc Read Only Memory) is a format that uses the CD format as a computer storage medium. It can handle 550 Megabytes of data and other mixed media.

CD-V (Compact Disc Video) is the third of the Philip's CD family to be introduced, an analog/digital hybrid capable of playing both CD audio and a 5-minute full-motion video clip of the artist who is playing.

CVD is an analog/digital hybrid capable of delivering interactive mixed-media applications. It is capable of playing either 10 or 20 minutes of full-motion video, depending upon whether it is in CLV or CAV mode.

CD-WO (Compact Disc Write Once, Read Many) is the writable version of the CD-ROM family.

CD-X is an all-digital CD-I format capable of full-motion, full-frame video.

CLV (Constant Linear Velocity) is an "extended play" disc which maintains a consistent length for each frame, enabling longer playing time per side, but individual frame addressability is not possible.

Compressed Audio is a system of recording and transmitting audio information in highly compact form by encoding and decoding conventional audio signals digitally.

Computer Generated usually refers to text and graphics created, stored and produced entirely by a computer.

Desktop Video is the generic term for video programs which are recorded and edited on small-format equipment including graphics and special effects generated by a personal computer.

Digital Images are images created with a computer and projected on a cathode ray tube for filming or scanned directly on the film with a laser.

DVI (Digital Video Interactive) uses advanced compression techniques. DVI gives the CD-ROM disc the ability to store and interactively process over an hour of full-motion, full-frame, low resolution video. Still in its infancy, DVI will take several more years before better resolution, low cost and availability make it readily available for use.

EDOD (Erasable Digital Optical Disc) is a totally erasable CD-ROM.

Expert System is an interactive program which solves problems or makes recommendations based on users' responses to a set of questions and a "knowledge base" and system of if-them rules. The goal of these systems is to document and provide high-level expertise to novices.

Frame is a single, complete picture in a video or film recording. A video frame comprises two interlaced fields.

Graphics Table or Tablet is a sensitive board which acts as a canvas through which computer-generated graphics can be designed. A handheld input device is used to draw freehand, to block out geometric shapes and to transmit instructions.

HDTV is the acronym for High Definition Television.

Hypercard is a Macintosh-based software product developed by Apple, which enables users to idiosyncratically organize information in a manner like that of the user's own thinking.

Hypermedia is a classification of software programs which consist of networks of related text, graphics, audio files, and/or video clips through which users navigate using icons or search strategies.

Hypertext is a classification of software programs consisting of networks of related text files which users navigate using icons or search strategies.

Information Managers includes a new category of software products designed to give the user hypertext and hypermedia-oriented options with data manipulation, either independently or with the added assistance of software such as Apple's *Hypercard* and Owl International's *Guide 2.0*. These programs enable the user to access or store information in some random, unstructured or disconnected fashion, and retrieve this data using some intuitive or relational query.

Interactive Video concerns the convergence of video and computer technology: a video program and a computer program running in tandem under the control of the person in front of the screen. In interactive video, the user's action, choices and decisions affect the way in which the program unfolds. Many adjust the program based on the users actions. The number of available programs is rapidly increasing.

Laser Disc is the name popularly used to describe the reflective optical video-disc.

Light Pen is a remote control device which allows the user to write or draw on the screen of a cathode ray tube with an extremely sensitive photo-electric pen. It can be used to "read" the surface of the screen, input information or modify recorded data, and interact with a program.

LV-ROM (Laser Video Read Only Memory) is the analog/digital optical memory format used to produce the BBC's *Domesday Project* incorporating both digital data and graphics, and analog video. LV-ROM will continue to thrive on such projects until CD-ROM's DVI capability is equal to or superior to that of the videodisc.

Mastering is a stage in the production of a videodisc in which the master disc is cut.

Menu-Driven is a program built around a series of menus, which guide users through the available options.

MPC stands for Multimedia Personal Computer, a trademark for software and hardware systems, that conforms to the MPC trade association standards and includes support for CD-ROM, digital audio, and high-resolution graphics in a Windows environment.

Multimedia, for the purpose of this project, shall refer to any hardware/software systems containing two or more media technologies integrated and coordinated by a personal computer.

Optical Disc is a recording medium for video or digital information in which a laser records or plays back holographic records of coded information onto successive frames. Vast amounts of data can be stored.

Overlay contains the facility to superimpose computer-generated text and graphics over a video image.

PAL is phase alternation line--the European video standard.

PC-VCR is NEC's name for their S-VHS videocassette recorder which can be controlled by a personal computer to support interactive video, video databases, and computer-controlled editing.

Pixel is the picture element used as basic building block of picture.

PSS is a performance support system, a computer-based point-of-use interactive "job aid" which helps users perform their jobs by providing help, brief tutorials, examples, on-line information, or problem-solving.

Quick Time refers to Apple Computer's multimedia technology which supports the storage and distribution of motion video, stills, and audio over local area networks.

RAM (Random Access Memory) is computer memory which can be both read and written to by the computer user.

Raster is a television-like projection of numerous electrons emitted as a beam from one or more phosphors (usually three for full color) in predetermined scan lines across the inner front face of a cathode ray tube, completely refreshed with a new image many times per second.

Reflective Optical Videodisc is the format that uses lasers to write and read a videodisc. A writing laser turns video, audio and control signals recorded on video tape into a pattern of shallow pits along a spiral track on a class master disc. Copies are pressed in plastic with metal "stampers" molded on the glass master.

RGB is a high-quality color screen used with many computers, and increasingly with video systems.

ROM is the smaller part of a computer's memory, in which essential operating information is recorded in read only format.

Scaling is the process of uniformly changing the size of images.

Search is the process in interactive video systems of requesting a specific frame, identified by its unique sequential reference number, and then instructing the player to move directly to that frame, forwards or backwards, from any other point on the same side of the disc or tape. Some video discs now allow seachs from either side of the disc.

Step Frame involves moving through a video sequence frame by frame, forward or backward, either automatically or remote control.

S-video is a type of video signal used in the Hi8 and S-VHS videotape formats.

Teleconferencing is a real-time multi-point communication using voice with still frames of motion video by means of phone lines or satellite broadcasting. This may include multiple channels for two-way phone conversations and other data forms. This is evolving into the current computer based video conferencing service now available.

TIFF (Tagged Image File Format) is a bit map file format for describing and storing color and gray scale images.

Ultimedia is an IBM trademark for their multimedia hardware systems composed of personal computers with CD-ROM players, and optionally DVI digital video capabilities.

VESA is the acronym for Video Electronics Standards Association.

VGA means Video Graphics Array, a Standard IBM video display standard that provides a 640 x 480 pixel resolution.

Virtual Reality is the display and control of synthetic scenes by means of a computer and peripherals which sense a user's movements, such as datagloves, helmets, or joysticks. These systems allow users to vicariously interact within "virtual worlds."

Videodisc is a generic term describing a medium of video information storage which uses thin circular plates, usually primarily composed of translucent plastic, on which video, audio and various control signals are encoded, usually along a spiral track. Optical disc systems use a laser beam to read the surface of the disc; so far they are divided between reflective and transmissive systems. Capacitance systems employ a sensor or stylus and are grooved or grooveless.

Chapter 2

LITERATURE REVIEW

Overview

The review of the literature for this project included a survey of professional journals, Educational Resources Information Center (ERIC), and texts related to multimedia in the learning environment. The review focused on items related to (a) current hardware and software technology availability, (b) implications for campus-based and distance learning, and (c) important considerations to be included in a multiyear plan for the integration of multimedia into the learning environment pertaining to instructional, organizational, and human resource development (HRD).

In a recent years major technological advances have both reduced the cost and increased the capability of information technologies. These advances are fueling major changes in organizational structure and the way business is done. Technical colleges are not exempt from these forces for change. Information availability and the ability to access that information are rapidly becoming standards by which all educational institutions are evaluated. Colleges are being pushed by these changes to begin a metamorphosis from the long standing teacher-centered learning paradigm toward a student-centered, technology-based learning paradigm similar to that shown in Figure 1.

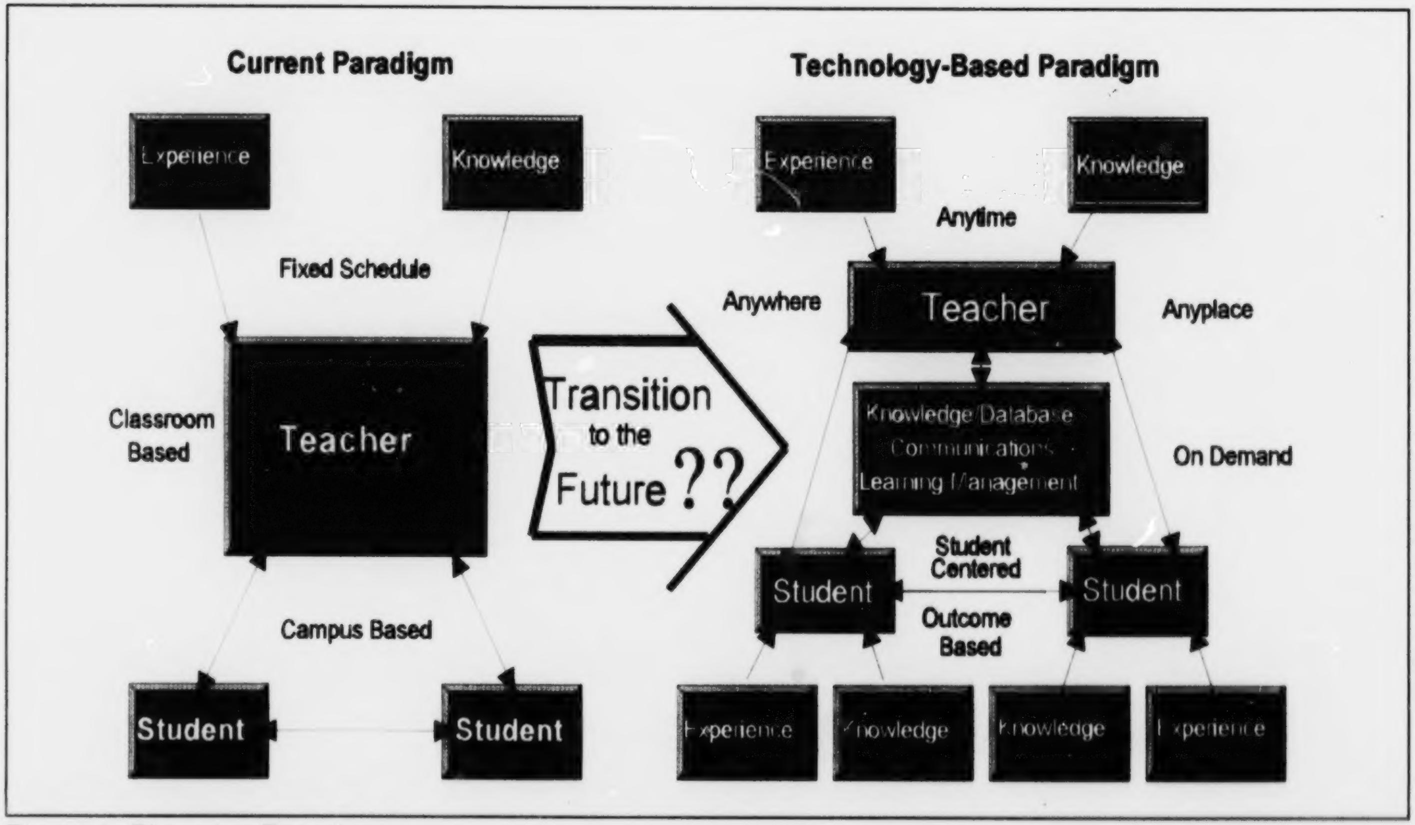
Current Paradigm
Technology-Based Paradigm
Experience
Knowledge
Fixed Schedule
Classroom Based
Teacher
Campus Based
Student
Student
Transition to the Future??
Experience
Knowledge
Anytime
Anywhere
Teacher
Anyplace
Knowledge Database
Communications
Learning Management
On Demand
Student
Student Centered
Student
Outcome Based
Experience
Knowledge
Knowledge
Experience

Figure 1. Changing Paradigms

Note: Adapted from Branson, R.K. (April, 1990). Issues in the design of schooling: Changing the Paradigm. Educational Technology, 30, 7-10.

This force for change is not something radically new. As early as 1982 the Office of Technology Assessment (OTA) of the United States Congress concluded as follows:

> The so-called information revolution, driven by rapid advances in communications and computer technology, is profoundly affecting American education. It is changing the nature of what needs to be learned, who needs to learn it, who will provide it, and how it will be provided and paid for. (1982, p. iii)

It seems evident that addressing issues resulting from technological change will be a major leadership challenge of the future.

Hardware and Software

Hofstetter (1995, P. 3) offers the following definition of multimedia:

> Multimedia is the use of a computer to present and combine text, graphics, audio, and video with links and tools that let the user navigate, interact, create, and communicate.
>
> This definition contains four components essential to multimedia. First, there must be a computer to coordinate what you see and hear, and to interact with. Second, there must be links that connect the information. Third, there must be navigational tools that let you traverse the web of connected information. Finally, since multimedia is not a spectator sport, there must be ways for you to gather, process, and communicate your own information and ideas.
>
> If one of these components is missing, you do not have multimedia. For example, if you have no computer to provide interactivity, you have mixed media, not multimedia. If there are no links to provide a sense of structure and dimension, you have a bookshelf, not multimedia. If there are no navigational tools to let you decide the course of action, you have a movie, not multimedia. If you cannot create and contribute your own ideas, you have television, not multimedia.

It is evident from this that all aspects of multimedia, hardware and software, must be considered when planning to integrate multimedia into the learning environment.

Hardware

As technological innovation continues to gather speed, technology users will have to navigate a bewildering array of hardware choices and capabilities. Storage and/or delivery platforms are the heart of multimedia. Common storage platforms currently available include (a) interactive video, (b) digital platforms, (c) CD-ROM, (d) digital video interface, and (e) compact disc interactive. Mass information storage is currently found in digital format because it is a cheaper, faster, and more efficient way to deal with information no matter what the transmission medium (Galbreath, 1992b).

Computer technology is the medium that is connecting these previously independent information technologies. With the current pace of technological change, computer purchases should be made with future upgrade and expansion possibilities in mind. Basic computer systems currently being advertised have at least (a) a 486 CPU, (b) 4 - 8 Meg of RAM, (c) a 1.4 Meg floppy disc drive, (d) a 250 Meg Hard Drive, (e) a CD - ROM, (f) a sound card with speakers, and (g) an SVGA monitor. Many come packaged with a number of software programs making them multimedia ready, and are configured to be upgraded to the new Pentium computer chip and a variety of peripheral devices. Upgrades that may not only be feasible but desirable for the next few years include (a) hard drives with increased speed or capacity, (b) improved display adapter and monitors, (c) fax/modem interfaces, (d) network and host emulation cards, and (e) scanners and printers.

Hofstetter (1995) lists what he feels should be included in a low-budget system, a mid-range system, and a high-end system. The low-budget system would include (a) a 486sx 33MHz central processor, (b) 8 MB RAM, (c) an SVGA color display, (d) a mouse or other pointing device, (e) a CD-ROM double speed, (f) a 16-bit wave form digital audio, (g) audio speakers, (h) a 160 MB hard disk, (i) a 9600 baud modem, and (j) an inkjet printer. His mid-range system would include (a) a 486 DX/2 66 Mhz central processor, (b) 8 MB RAM, (c) SVGA color display, (d) mouse or other pointing device, (e) CD-ROM double speed, (f) 16-bit waveform digital audio, (g) audio speakers, (h) video overlay (with multiple inputs, frame capture, and Video for Windows capture), (i) videodisc with 2 second maximum seek time, (j) 400 MB hard disk, (k) external SCSI connector, (l) read-write optical disk, (m) network card, (n) TCP/IP network connection, (o) *winsock.dll* installed under Windows, (p) handheld scanner, (q) Hi8 camcorder, and (r) a 300 DPI laser printer.

The high-end system would include (a) a Pentium 90 Mhz central processor, (b) 16 MB RAM, (c) SVGA color display, (d) CD-ROM triple speed, (f) 16-bit sound card, (g) audio speakers, (h) video overlay (with multiple inputs, frame capture, TV tuner, and Video for Windows capture), (i) MIDI IN and OUT, (j) MIDI keyboard, (k) general MIDI external synthesizer, (l) videodisc (with CLV still framing), (m) 800 MB hard disk, (p) writable CD-ROM, (q) PCMCIA cards, (r) 14,400 baud modem, (s) network card, (t) TCP/IP network connection, (u) *winsock.dll* installed under Windows, (v) hand-held and flat-bed scanners, (w) slide scanner, (x) digital camera, (y) Hi8 Camcorder, and (z) a 600 DPI color laser printer. See Appendix G for a list of sources of technology information.

Unfortunately, more than one multimedia platform is available and none are completely compatible with the others. The first created by Microsoft and other manufactures is the Multimedia PC standard (MPC). IBM's Ultimedia line based on IBM's OS/2 operating system is the second. And the third is Apple Computer's Quick Time software-based system for displaying video. None are completely compatible with the other. This, in addition to rapid hardware and software obsolescence, complicates the planning function.

Hudson (1992b) feels that interested faculty can begin to explore the integration of multimedia into the learning environment with the following:

(a) a computer, (b) an authoring system (look for interactivity), and (c) a VCR (S-VHS) and/or a laserdisc player that interfaces with both the computer and the authoring system.

While stand alone activities have been and will continue to be a large part of computer usage, connection to a network is an even more important use for the future. Verity and Lewis (in Ferrante, Hayman, Carlson & Phillips, 1988) state:

> The emerging second generation [of computers] will be dominated by microcomputers and characterized by distributed resources and high-speed, fully connective peer-to-peer networks. The change is away from "monolithic back-office mainframes" to inexpensive microcomputers scattered throughout an organization and providing ready access to computing power. (p. 1)

Networking expands the computer's information processing capability. "The networks of the future (Ferrante et al., 1988, p. 15) will coordinate data bases from many disciplines and will ultimately bring together people in an information infrastructure. The move toward campuswide networking and connectivity will accelerate and shortly be considered the standard for all institutions" (Ferrante et al., 1988, p. 78). The old competitive reference points of bricks and mortar are being replaced by

> . . . information resources and tools available as reflected by (a) the number of locations on and adjacent to campus, that support mobile computing and network access; and (b) the kinds, quality, and currency of digital resources available on line via the campus library or information services center. (Green & Gilbert, 1995, p. 12)

As the pace of technological change has increased, the resulting useful life of computer equipment has decreased. The current useful life (Green, 1995) of computer systems is 24 to 30 months and software 12 to 16 months. Technological obsolescence (Green, 1995) is a structural component of technology-driven change, and should be met with budgetary processes that include capitalization and amortization plans for computer purchases; much different than the current standard budgetary process that depends upon grant funding and/or end of year surplus to fund computer purchases. This is due to the fact (Green ,1995, p. 54) that:

> Technology is no longer a new phenomenon for colleges and universities: it is now a key component of the infrastructure, central (and increasingly essential) to the instructional activities and scholarly mission of all types of institutions and across all disciplines.

Software

Dahmer (1993, p. 50) says "Software is to multimedia hardware what gasoline is to a car. Software makes the hardware run. Without it the hardware is next to useless." This fact makes selection of software an important part of multimedia planning as software capability must be matched to hardware capability. There are four types of software which are like layers of a pyramid with all layers necessary for the pyramid to stand (Dahmer, 1993):

1. The operating system -- This software manages the low-level functions of a computer system. Examples are MS-DOS, PC-DOS, Windows, Unix, OS/2, and System 7.

2. System-interface software -- This is a series of programs that with the support of the operating system allows users to access the multimedia system.

3. Authoring Systems -- They and their more complicated, powerful cousins called authoring languages allow people to quickly and efficiently develop multimedia training modules. Quest, TenCORE, LSI, Authorware, IconAuthor, and ToolBook are some of the authoring software systems currently available.

4. Courseware -- Courseware is produced as a result of the authoring process and depends upon the aforementioned software types to function properly. It is what a trainee sees and interacts with during a multimedia training session (Dahmer, 1993).

Choice of software types one or two are dependent upon the type of hardware purchased (IBM or Apple format). The primary software decision then lies in deciding whether to invest in commercially prepared courseware or an authoring system to fabricate "homegrown" courseware. Some of the commercially available multimedia software currently available (Oblinger, 1992) include (a) curriculum products, such as

Exploring Chemistry by Falcon Software and Logal Software's Explorer Science Series, (b) reference materials, usually on videodisc or CD-ROM, such as MicroSoft's Bookshelf and a variety of encyclopedias, (c) presentation tools, such as Harvard Graphics, Powerpoint, and Freelance Graphics and (d) student tools which allow students to develop projects, reports, and term papers that embody sound, images, and video.

VanHorn (1992) describes a promising software development, the Integrated Learning System, a microcomputer system that contains multi-year curriculum sequences. Current vendors developing ILS's include (a) Wicat Systems, (b) Computer Curriculum Corporation, (c) Precision Learning, and (d) Josten's Education Systems (ES) Corporation. The ES system contains 1800 lessons covering major objectives in math, reading and language arts which ar matched to the text used by the school.

When ready to implement the system, the school sends its texts to ES Corporation. ES Corporation matches a pretest, three different learning activities, a learning game/reinforcement activity, and a posttest to each of the texts objectives. The firm then installs the ILS on the school's, network and trains teachers in its use. While this endeavor is still primarily focused on the public schools it does hold promise at the postsecondary level as well. "Using an integrated learning system, schools have shown significant achievement gains - on the order of 55%

as measured on standardized tests" (VanHorn, 1992, p. 531). Perhaps the ILS has potential to positively impact the increasing calls for evidence of institutional effectiveness.

Choosing software can be just as bewildering as choosing hardware given the proliferation of new programs. However, there are some important criteria to observe. DeLaurentis (1993, March) lists the following criteria by which to evaluate software: (a) symbolic graphics that are representative of the subject being taught, (b) adaptability to students current knowledge and skill level, (c) student controlled, (d) medium matched to content (a combination of media choices should be available), (e) relational content (association between concepts is made explicit), (f) hierarchy of instruction (will evaluate whether the learner has the prerequisite knowledge), (g) thorough treatment of the content, and (h) knowledge of results (frequent and immediate feedback to the student). With the increasing complexity of software and hardware availability, it is important to "establish clear responsibility in a single unit to maintain current information on all relevant aspects of computing [and multimedia] and to keep decision makers informed of matters of concern" (Ferrante, et al., 1988).

Staying informed about changes in multimedia is also a matter of personal and professional necessity (Hofstetter, 1995) because . . . "the ability to use it is emerging as a life skill, [and] you will continually need to develop your multimedia techniques to stay competitive in your profession and live life fully in the information society" (p. 183). Several of the information sources Hoffstetter identifies are included in Appendix G.

The Need for Change

As indicated in the introduction, NMTC has experienced many of the strains being felt by other two-year institutions nationwide. Rising student costs and declining state funding support coupled with increased need for occupational training or retraining and a growing diversity of student body have made it increasingly difficult for NMTC to fulfill its mission.

Based on these issues and others, several people (Guskin, 1994; Phelps, 1994; Burke, 1994; and Doucette, 1994) point out the need to fundamentally restructure the teaching/learning process through the integration of new information technologies. Doucette (1994) illustrates this point with the following:

> The classroom economic model for higher education is becoming unsustainable, with decreasing state support the rule and increasing user fees beginning to strain the ability of individuals to afford the investment in college. Add to these the threat of serious private competition for educational programming, and it becomes clear that higher education must take seriously the challenge to reinvent a more effective productive model. Most argue that the key to such a model probably lies in improvement made possible by the application of information technology. (p. 20)

Concerning this new model Groff (1991, p. 32) says:

> The challenge in the technical society is to redesign the education and training delivery system so that it is user controlled, relevant, state-of-the-art, magazine styled programming that the consumer can use it when it is needed, where it is needed, as often as needed, see any part of the sequence, and be based on the latest brain research about how humans learn at various stages of development.

Findlen (1994) points out that complex social organizations that do not evolve and adapt to changing societal expectations will not survive. Technical colleges are no exception. Technical college leadership must realize that free enterprise governs higher education as it does other service industries. They "must be aware that there are aggressive private colleges [and private industry] willing to come to their cities to offer classes on nights and weekends" (Findlen, 1994, p. 32). Societal change, technological change and information availability are tugging at their very foundations. "It is a long held principle (Phelps, 1994, p. 25) that technology becomes accepted when an organization can no longer afford the old labor-intensive, more expensive way of doing things".

Much of the impetus for increased effectiveness and efficiency is provided by the rapid emergence of the global marketplace predicted by Naisbitt and Auberrdene (1990). New skills are needed for success in the new environment. However, competensies and skills developed by those going through current education and training programs in the U.S. are not adequate to be globally competitive (Fitzsimmons, in McCabe, 1994).

Sanchez (1994) contends that the development of a globally competitive and skilled work force can be accomplished by a focus on student-centered learning:

> To accomplish this implies an increased use of technology for learning, which has not been utilized in the educational process to the fullest extent possible. The appropriate use of technology will result in a more cost effective instructional program. Through technology, we can gain efficiency and effectiveness combined with an emphasis on student-centered learning. . . . The use of technology combined with a focus on student learning and implementation of changed pedagogy will result in more quality without increased costs, a formula for success in the 90's and beyond. (p. 2)

Doucette (1994) agrees that the key to this restructuring of the learning process will be based on a shift of focus of control from teacher to student. Faculty will retain control over content, design, standards, and assessment of learning. They will give up control over the delivery mechanism empowering students to choose how they acquire information and how they learn. The focus (Doucette, 1994, p. 23) will

> . . . not [be] on content but on transferable skills that are the learning outcomes of courses and programs - the ability to gain access to information, to interpret it, to give it context, to use information, to solve problems, and to collaborate with others in problem solving.

Robert Reich (in Wirth, 1992,) calls these skills the skills of symbolic analysis:

> 1. Abstraction - the capacity to order and make meaning of the massive flow of information.
> 2. System thinking - the capacity to see the parts in relation to the

> whole to discover why problems arise and how they are linked together.
> 3. Experimental inquiry - the capacity to set up procedures to test and evaluate alternative ideas.
> 4. Collaboration - the need for active communication to get a variety of perspectives, as well as the capacity to create consensus when that is necessary. (p. 185)

Working with computer based tools lends itself to process oriented learning, which fosters the development of these foundation skills of the future (Callon, 1992).

On the issue of institutional effectiveness Phelps (1994) says:

> Community colleges have declared themselves to be the most cost-effective means of training the nations workforce and providing economic development leadership. However, is that declaration realistic without abandoning the old academic structure? Can we be on the cutting edge of economic recovery and economic development as long as we cling to what may be described as an outmoded academic model - a model more suited to the convenience of the institution than to business, industry, or the student returning to acquire new skills. (p. 25)

Evidence of the negative effects of this outmoded academic model is provided by the Maine Council on Vocational Education (MCVE, 1993) in the following:

> A major problem for service providers is the issue of timing of client needs versus class startup. It is difficult for JTPA to find skill training for their clients after the school year has begun. Since the technical colleges and adult education do not offer year-round schooling or modular programming, it is not possible for JTPA clients to enter training in a timely manner. Clients' benefits may be exhausted before they can enter vocational programs, so many of them cannot access appropriate skill training. The depressed economy has been responsible for a large increase in the number of people applying for

> programs at the technical colleges. . . . The recession has produced a new type of dislocated worker. Many of these people do not need the usual remediation and retraining because they have college or technical degrees. Since the retraining options for these workers is limited, many leave the state. (p. 33)

Clearly, the current academic model is not effectively delivering needed services to this group of people. As lifelong learning becomes a fact of life, distance education will become increasingly important for adult students and others with multiple life and work responsibilities unable to attend regularly scheduled classes on campus (Doucette, 1994).

Institutional effectiveness is closely related to faculty productivity. Guskin (1994, p. 16) feels that "significant increases in faculty productivity will only be possible by fundamentally restructuring the work of faculty members." He contends:

> . . . faculty can effectively and efficiently use new technologies in a way that will enhance and/or often substitute for a good deal of their present teaching method, thereby freeing them to spend more time with more students and to have a greater impact on the learning of all these students. (p.20)

However, Green and Gilbert (1995) conclude that information technology will not lead to the kinds of productivity gains currently touted anytime soon. They feel that institutions would be better served to expect major substantive benefits from more widespread academic use in the area of content, curriculum, and pedagogy. The three primary reasons we must invest even if increased productivity may not occur quickly

(Green & Gilbert, 1995) include (a) competitive position, (b) teaching, learning, and curriculum enhancement, and (c) student preparation.

Pina and Savenye (1992) predicts that the new faculty role will include the following skills:

1. Instructional designer;
2. creator of learning environments, particularly interactive;
3. organizer, controller, evaluator of student-centered learning;
4. user of varied instructional delivery systems;
5. subject matter expert (teaching & learning) for interactive educational software development;
6. developer of interactive computer materials, utilizing authoring systems;
7. user of computers and other technologies as instructional delivery tools; and
8. user of computers as administrative tools.

Information resources and ready access to those resources are becoming the standard by which institutions are compared. Kozma & Johnston (1991) list the following ways information technology can be used to transform teaching, learning, and the curriculum including: (a) from reception to engagement, (b) from classroom to real world, (c) from texts to multiple representations, (d) from coverage to mastery, (e) from isolation to interconnection, (f) from products to processes, and (g) from mechanics to understanding in the science lab. Student preparation for the real world will be enhanced by the routine use of information technology in the learning environment emulating technology use at home and work.

The restructured learning environment, based on mastery learning concepts, will be student-centered and allow students to proceed at their own pace receiving credit for work completed. Preliminary success of this approach [within League of Innovation] is evidenced by high completion rates, high demand for courses, strong student preference for self-paced approach, and increasing numbers of faculty who say they will never return to classroom-based instruction (Doucette, 1994). Some educators still express concerns about potential lack of student/faculty interaction resulting from implementation of new technologies and teaching methods. To this, Doucette (1994, p. 22,23) says:

> . . . the best designed computer-based instructional systems do not isolate students, but provide opportunities for regular contact with faculty, learning specialists and peers. They have also solved the problem of cost by redesigning the instructional model, rather than simply treating the technology as an add-on cost for existing systems. Well designed and properly implemented, computer-assisted, independent learning systems are effective in increasing student learning at acceptable costs - but only those systems that attempt to transform the teaching and learning process, not to automate the existing classroom-based paradigm, are likely to accomplish these goals.

Technology must become an integral part of the learning environment to yield its full potential.

Educational Potential of Multimedia Technology

Expert Opinion

New media technology has the potential to affect change in many aspects of the current educational model. "The most dramatic change will be in the ability of institutions, especially smaller colleges, to offer a wide array of facilities to students in remote locations, despite limited resources" (Waterhouse, 1991, p. 91). New information technologies offer the potential to take the learning process to students at their location based on their schedule needs, instead of those of the institution. Romiszowski (1993, p. 4) says ". . . the costs of telecommunications are falling where as the costs of educational space, staffing, and transport are rising, so that over time the economical equation will favor the increased use of telecommunication-based education."

"Technology can help higher education link access and excellence by tailoring learning to the diverse student needs and styles. It will allow colleges to respond to critics by containing costs while improving quality" (Burke, 1994, p. 2). Townsend (1992) lists six benefits of multimedia including the following:

1. It reaches all ages.

2. It encourages and validates self-expression.

3. It gives a sense of ownership to the user.

4. It creates an active learning environment.

5. It fosters communication between faculty and between students and faculty.

6. Its use makes a lot of sense to the teacher of today given the availability of technology in the everyday life of students.

Research Review

A preliminary review of the research on multimedia or technology based instruction shows varied results Pryor (1992). Some (Clark, 1984; Dence, 1980; Leiblum, 1981) found no significant difference between technology based instruction (TBI) and conventional instruction. Others (Atkinson, 1984; Bangert-Downs, Kulik & Kublik, 1985; Fletcher, 1990; Fletcher, Hawley, & Piele, 1990) found TBI to be more effective than conventional instruction (Pryor, 1992). This may be due to differences in the design of specific TBI projects. Or, as Yildiz and Atkins (1992) suggest, this may be the result of the use of comparative research strategies usually conducted under laboratory conditions rather than in classroom settings. However, based on an intensive literature review on the multimedia effectiveness research of several researchers from the 1950's to present, Yildiz and Atkins (1992) found the following:

1. IV simulations have a positive attitudinal effect on learners.

2. Effective use of IV simulations in secondary school science lessons may improve standards of laboratory work and save time in comparison with setting up normal experiments.

3. Tutorial IV simulations in science can significantly increase student performance on laboratory reports and test scores.

4. There is no significant difference between the cognitive effect of IV laboratory simulations and standard laboratory instruction in teaching college level pure science.

5. IV's visual images can help college students to understand some physics principles better.

6. IV simulations can enable students to visit a real place and move around in time and space to investigate, sample, analyze, and test possible ideas within the environment.

There are an increasing number of accounts of successful use of multimedia in the learning environment. Pryor (1992) reports that preliminary research on teaching with interactive videodisc shows

> . . . considerable evidence that even brief use of the prototype interactive system had significant added instructional value compared with conventional instruction alone. . . . The subjects who were taught with interactive video outscored arguably more able and advantaged peers on three objective performance tests. (p. 9)

Reporting the results of a pilot project using multimedia in college math classes, Callon (1992) found that

> . . . use of computer technology in calculus classes led to students demonstrating a much better grasp of fundamental concepts and they are more adept problem solvers than those taught under traditional format without any loss of computational or manipulative skills. Formal class evaluations . . . documented improved student attitudes toward learning and increased faith in their abilities to work things out for themselves. Instructors . . . also noted that students are better at working independently, and yet seem to have developed more of a working relationship with their instructors and with their classmates. (p. 22)

Louie, Sweatt, Gresham and Smith (1991) feel that science and math videodiscs hold real promise for increasing math and science interest and understanding. At Burkburnett High School in Burkburnett, Texas they report that interactive videodisc used in the science classes (a) increased enrollment in third and fourth year science classes, (b) decreased failure (down 19%) rates in physical science classes, and (c) resulted in longer retention of knowledge. Advantages they cite include (a) detailed graphics, (b) pacing for individual needs, (c) immediate student feedback, (d) academic monitoring that helps teachers tailor instruction to student needs, and (e) effective time management. "This interactive technology lends itself to and encourages increased peer tutoring, cooperative learning and critical thinking among students" (Louie et al., 1991, p. 23). Adding educational efficiency and effectiveness to the discussion, Dykman (1994) reports that the Hudson Institute found computer aided instruction (CAI) to result in 30% more learning, 40% more time savings, and 30% less overall cost.

Ehrmann (1995) lists three examples of multimedia use in higher education. The first, Rensselaer Polytechnic Institute, has used technology to virtually eliminate lectures from its introductory physics and calculus courses. Physics 101 has reduced the usual six hours per week class time to two-hour sessions per week using software called the Comprehensive Unified Physics Learning Environment (CUPLE). It includes a web of multimedia instructional materials. The second, Indiana University Purdue University at Indianapolis, has broken the 1300 students that enroll in Introductory Psychology into smaller collaborative groups in which faculty are not allowed to lecture. They are charged with fostering learning and are given wide latitude in accomplishing that task. The third, the Odyssey Project at Arizona State University, has altered the traditional " sleep and slides" introductory humanities course that enrolls 130+ students per section to a computer-based, collaborative exploration by student teams. The average attrition rate dropped from the usual 30 - 35% to 10% in the first semester of use. All these initiatives have resulted in greater satisfaction by students and faculty and are paving the way for others to begin the transition from the teacher-centered paradigm to the student-centered, technology-based paradigm.

These three projects exhibit the common elements of fostering more student responsibility for learning while giving students more material worth learning. These reports of classroom multimedia successes seem to indicate that proper utilization of multimedia technology can have positive effects on the NMTC learning environment.

The rapid advances in hardware and software capabilities are dramatically increasing the impact that the knowledge/database and communications aspects of the technology-based model have on the overall learning environment. These advances create new demands and options for learning management. Dyrli & Kinnaman (1995) predict the major aspects of a technology-based learning environment will include (a) content decision making will be distributed across networks and placed in the hands of users; (b) students and teachers will have a huge diversity of information choices for achieving educational goals; (c) learners will get information on demand, when and where they want it; (d) two-way interactive media will predominate, and (e) education will not be location-dependent, because learning at home and through home-school-community connections will be predominant. It is their prediction ". . . that the multimedia PC hooked up to a massive network of digitally connected learners and resources, will soon rule contemporary culture as surely as broadcast television ruled it for the last four decades" (p. 41,42).

Important Considerations In An Action Plan

Change Process

No matter how strong the potential for change in the educational process through technological innovation may be, that change will not be automatic or occur overnight. Kathy Stash (in Dykman, 1994, p. 40) says, "There is a long way to go between the hype, hope, and promise of technology and actually making it a reality. There are financial and cultural barriers." Kinnaman (1994) warns of two threats to successful integration of technology into the learning environment. They are (a) those who resist almost anything that challenges the status quo, and (b) an involuntary perspective shared by many more people, that the basic structure of American education is not open to modification. However, even though technology is one of the most explosive issues on campus (Phelps, 1994), it can be of great value to the learning process if faculty seize the responsibility for it.

A major part of any strategic mulityear plan for the integration of multimedia technology into the learning process must include a process that addresses people's concerns and fears enabling them to feel comfortable with the change process (Bauldin, in Baltzer, 1991). Such a framework is necessary to guide the change process that must take place if new technology is to transform the way faculty teach and students learn.

Bennis (1989) says: "Constant as change has been in this century, vital as it is now, it is still hard to effect because the sociology of institutions (any group of two or more people) is fundamentally antichange" (p. 147). Therefore, a major issue to be addressed in this project, other than resources, is the change process.

Change is frightening (Findlen, 1994) because it requires we leave the familiar ways of the past in order that we might face an unknown future. Several scholars (Hall, 1979; Hall & Hor, 1987; Loucks, 1983; Kilpatrick, 1985; and Sayles, 1990) have researched and written about change and how to successfully facilitate the process. Successful integration of technology into the learning environment will take vision, leadership, and patience. Three to five years is the usual time frame mentioned in the literature for successful adoption of innovations.

Hord, Rutherford, Huling-Austin, and Hall (1987) list the following reminders:

1. Change is a process, not an event.
2. Change is accomplished by individuals.
3. Change is a highly personal experience.
4. Change involves developmental growth.
5. Change is best understood in operational terms.
6. The focus should be on individuals, innovations, and the context.

Osborne (1993) lists several strategies that facillitate the change process. They are (a) active participation, (b) face-to-face interaction, (c) opportunities to learn new behaviors, (d) local materials development, and (e) support from campus leadership.

A well researched and validated change model that encompasses these concerns is the Concerns Based Adoption Model (CBAM). This model describes the various levels of concern that individuals go through as they metabolize the change process (Hall & Rutherford, 1975). The CBAM questionnaire identifies seven stages of concern that individuals go through during a change process. The stages, numbered 0-6 are as follows (Osborne, 1993, p. 11):

0. Awareness – people must be aware of the intended change.

1. Information – people must know about the intended change.

2. Personal – individuals must understand how the change will affect them personally.

3. Management – management issues must be addressed. How will this change fit into a busy day?

4. Consequence – what difference will it make to me and to my students?

5. Collaboration – the organization needs to digest the change and adjust. How does this affect us?

6. Refocusing -- how can we make the change better or improve on what we are doing?

The CBAM questionnaire allows change agents to assess what stages of concern exist in an organization, identify possible intervention strategies, and ascertain how successful intervention strategies were in addressing people's concerns.

Human Resource Development

The rapid changes occurring within our society make it more necessary than ever that technical colleges foster a philosophy that values lifelong learning and embraces change as an ongoing aspect of institutional operations. Stern (1989, p. 1) links staff development and lifelong learning and change process:

> Because the fact of change is so much a part of our lives today, and because it is a central part of the community college role in our society, the concept of lifelong learning becomes a critical part of the community college. Change means that continuous learning is a fact of life for adults. The community college is uniquely designed to meet the need for continuous, or lifelong learning. It is simply an extension of this reality, that the staff who work in community colleges must themselves be lifelong learners. Staff development is lifelong learning.

"When the climate of learning for staff is open, flexible, affirming, challenging, the climate of learning for students is likely to be similar" (O'Banion, in Stern, 1989, p. 1). The core of the learning process is an eager and involved faculty working to grow personally and professionally.

However, meaningful change will not be accomplished unless individuals in the organization are convinced of the need to do so. The primary focus of any staff development program must, therefore, be the individual and how that person reacts to, or accepts change. This reaction is deeply imbedded in a person's stage of development and its associated thinking and learning style. The program must be based on adult learning theory and focus on meeting the needs of the individual if organizational needs are to be met. Sinclair and Skerman (in Ovando, 1990) list the following andragogical based human resource development program goals:

1. to provide an environment where participants take control of their learning process;
2. to provide a wide range of resources to facilitate the individual learning process;
3. to encourage the development of initiative, autonomy, and risk taking in seeking out learning opportunities;
4. to allow maximum opportunity for participants to achieve individually set goals, relevant to their own learning needs or perceived institutional needs;
5. to maximize the use of participant's own internal motivation and felt need;

6. to provide a design where participants adopt a learning pace and style appropriate to their own background, and

7. to provide an environment in which individuals are stimulated to explore new possibilities.

Selman and Shum (1990, p. 1) link the value of staff development to the current reform movement with the following:

> Educational reform is taking place and will continue to occur within technical colleges. The availability of effective administrative leadership, classroom/laboratory teachers and support staffs will be the key to any meaningful and lasting reform. . . . The majority of today's technical college administrative staffs were recruited from the ranks of yesterdays successful teachers. Most technical teachers were (and will continue to be) recruited into teaching from the ranks of practicing technicians. Although occupational work experience is vital to technical education, it does not by itself assure success in providing effective educational programs or qualified personnel.

Elements often found in successful programs listed by Stern (1989) include (a) mechanisms for mutual planning, (b) institutional and professional needs assessments, (c) self-assessment, (d) cooperation with other community colleges in the region, (e) a variety of activities and opportunities, (f) appropriate incentives, (g) evaluation of individual offerings and the total program, (h) widely publicized staff development opportunities promoted through a variety of media, (i) a statement of goals, (j) widespread use of professional and personal development plans, (k) demonstrated support of staff development by the administration and the board of trustees, (l) clearly stated program goals and objectives supporting institutional mission and goals, and (m) activity is year-round with primarily voluntary participation. Successful programs stretch faculty to see beyond their own individual growth and to understand their impact on students and the institution.

Planning Process

With so much at stake, both financially and educationally, adequate planning mechanisms are a must. "Technology plans are a good start toward resolving the problems caused by willy-nilly purchase of equipment" (Kirby, 1994, p. 44). "Existing planning mechanisms have not coped well with the changing technology. While everyone knows about microcomputers, few understand the challenge of its technology" (Ferrante, Hayman, Carlson, & Phillips, 1988, p. v).

As previously shown in figure one, a technology plan supporting the development of a student-centered, technology-based learning environment must focus on three major components (a) the knowledge/ database, (b) communications, and (c) learning management. "A fundamental issue (Roth, Gooler, Teslowski & Winters, 1990, p. 3) is how to use these information technologies to actually improve teaching, learning, and educational opportunities . . . without creating other problems."

While several experts have attested to the importance of an organized strategic planning process, (Ferrante, et al., 1988, Cope, 1987, and Handy, 1990) the process is only as good as the information upon which it is based. That information must be provided by an effective environmental scanning process which is an integral part of the strategic planning process. (Friedel & McHenry, 1990; Newsom & McHenry, 1990; Clagett, 1987; Lapin, 1992, and Mecca & Morrison, 1988).

Organizational context determines what environmental variables are of particular importance. From a business perspective, the environmental contexts that should be monitored (Clagett, 1987) include (a) demographic, (b) economic, (c) legal-political, (d) competitors, (e) socio-cultural patterns, and (f) technological change. From an educational perspective, Oakland Community College (Orlowski, 1995) focuses on (a) educational trends, (b) occupational trends, (c) enrollment, (d) economy, (e) resources, and (f) regulations. For this project, the trends categories selected for inclusion were (a) demographic, (b) economic, (c) educational, (d) legal-political, (e) competitors – public and private, and (f) technological and occupational.

Another major foundation upon which a plan for integrating technology into the learning environment is based is the vision statement. It sets the tone for the kind of learning environment people aspire to create in the long term. Typically (Kotter, 1990) a vision is specific enough to encourage initiative and to remain relevant under a variety of conditions. It must be both desirable and feasible. Kotter (1990, p. 43) says:

> The development of a good [organizational] direction is not an act of magic. It is mostly a tough, sometimes exhausting, information-gathering and analytical process. People who develop such visions and strategies . . . tend to be broad-based strategic thinkers who are willing to take risks.

The vision statement should be the eye to the future and set the necessary direction for future actions and planning.

Moursund (in Roth, et al., 1990) identifies eight flaws commonly found in hastily prepared technology plans:

1. Inadequate participation and ownership by all stakeholders;

2. inadequate consideration of articulation issues, both within the institution and outside the institution;

3. failure to address the testing issue (will educational technology be used as part of the testing environment);

4. failure to address equity issues;

5. failure to provide permanent funding;

6. failure to consider changes that may occur as substantial units of study become available through computer-assisted-instruction or other distance education modes;

7. failure to provide for adequate evaluation (both formative and summative); and

8. failure to provide for annual review and update of the plan.

Fife (in Ferrante, et al, 1988, p. xvi) says, "Adequate planning for microcomputers [and multimedia] is absolutely necessary if institutions are to be prepared to educate their students to meet the challenges of the 21st century." Dively (in Roth et al., 1990) reminder planners that

1. technology is a means, not an end;

2. technology requires a re-evaluation of roles, missions and services;

3. different situations require different technologies;

4. technology changes rapidly;

5. new technologies are not always the best;

6. instruction, not technology, is the largest factor affecting program quality; and

7. faculty involvement is critical for success.

The major goals of any technology plan should include (a) increased access to learning opportunities and (b) increased student achievement and learning efficiency.

Ferrante et al. (1988) recommends the following planning strategies to facilitate technological change in higher education:

1. Consider strategic planning with environmental scanning as an effective planning model for integration of technology.

2. Establish a central authority at the level of vice president to coordinate all planning and implementation of campuswide networks.

3. House all responsibility for computing in a single unit and disseminate information to all members of the campus community.

4. Involve all faculty and staff continually in planning the campus information system.

5. Develop an organizational infrastructure that supports campuswide use of microcomputers [along with other types of media] and the broader use of networks.

6. Integrate all curricula within campuswide networks with the support of requisite instructional software.

7. Secure every method possible for long-range financial support for development, including federal, state, private and local sources.

8. Train all users as a continuous, centralized function with a budgeted allocation of instructional resources.

9. Make synergy the goal of campuswide networks to improve access to resources and universal use of information.

10. Establish a detailed plan to develop and operate the system, to address users needs, and involve faculty and staff.

The student author of this project was a member of the NMTC strategic planning committee and involved in various institutional planning activities associated with that involvement. This project was connected to the institutional strategic planning process and supported by NMTC leadership (see Appendix H).

Summary

Technological innovation is fostering rapid changes in organizational structure and mission of most societal institutions, and higher education is no exception. Several converging forces are fostering the evolution of a new learning environment including (a) increased costs for educational space, staffing, and transport, (b) decreasing public funding, (c) changing student expectations, (d) global competition, and (e) the need for continuous lifelong learning.

As new information technology becomes an integral part of the learning environment, the learning process experienced by students will be more student-centered and allow greater student control of and responsibility for the learning process. Faculty roles will shift from those of the knowledge provider to those associated with being a facilitator of learning. The focus will be on learning outcomes, not teaching outcomes.

This transition must be supported by an organized planning process supported by an ongoing environmental scanning process and an adequately funded HRD program. This HRD program must be andragogical based and guided by an understanding of the change process and its effect on people.

Dealing with resistance to change and providing adequate funding for acquisition and maintenance of new technology will be an on-going challenge. However, the greatest challenge may be that of providing the necessary HRD resources to assist faculty to utilize technology in the most effective and efficient manner as they make the transition to the student-centered, technology-based learning environment of the future. Even with these challenges, it appears that integration of multimedia into the learning environment has the potential to assist NMTC to be more effective and efficient in fulfilling its mission of preparing an educated, skilled, and adaptable labor force responsive to the workforce needs of Maine's employers (NMTC, 1994).

Chapter 3

METHODOLOGY AND PROCEDURES

Methodology

The development problem-solving methodology was used in this project. Seminar, practicum project, and summer institute work provided the conceptual framework for this project. A multi-year plan for the integration of multimedia technology into the learning environment at NMTC was one product resulting from this project. However, the real benefit realized during this project was the human resource development that occurred among NMTC personnel and other participants.

Procedures

Although several procedures were included in this project, they basically consisted of two major activities: data gathering and plan development. The steps in the data gathering activity consisted of three basic steps including (a) an intensive literature review, (b) an audit of the internal environment, and (c) an assessment of the external environment. The plan development process, adapted from Collins (1993), utilized eight steps including (a) a review of the data gathered, (b) a listing of pertinent trends and issues, (c) creation of a vision statement, (d) determination of possible actions-options, (e) a trade-offs analysis, (f) prioritizing preferred futures, (g) listing of goals, and (h) preparation of a multiyear plan.

Data Gathering

Literature Review

The data gathering activity began with an intensive literature review to (a) ascertain the need to include multimedia in the learning environment, (b) analyze current information technology (hardware and software) available, (c) identify research and expert opinion concerning the educational potential of the new information technologies, (d) identify examples of the integration of information technology in the learning environment, and (e) identify important aspects of the planning processes that should be included in a multi-year action plan for multimedia integration into the learning environment at NMTC. Also as part of the data gathering process, a review of institutional mission and goals, and an internal and external environmental analysis was done to provide context for the planning process. The analysis of internal and external environments sought to evaluate institutional strengths, weaknesses, opportunities, and threats pertinent to the integration of multimedia technology into the learning environment at NMTC.

Audit of The Internal Environment

This part of the data gathering activity involved seven activities aimed at identifying internal factors having a bearing on this project. These included (a) an assessment of institutional multimedia capability (hardware and software), (b) a review of institutional strengths and weaknesses identified in the 1995 NEAS&C self-study report, (c) an assessment of the current usage of the bulletin board system and the main campus computer network, (d) an assessment of the levels of concern of faculty and administrators regarding multimedia use, (e) a review of department action plans to identify goals and objectives pertinent to this project, (f) a review of current strategic planning goals pertinent to the project, and (g) a review of internal data pertaining to the current and projected funding conditions.

In step one, a physical inventory (see Appendix I) of available equipment was conducted to ascertain the current potential for multimedia use in the learning environment. Faculty were also surveyed to determine the types of software they used in the work environment and whether the uses supported administrative or classroom functions. The survey was validated through the review of three internal experts. Step two involved a review of the institutional strengths and weaknesses identified in the 1995 NEAS&C accreditation self-study report to identify those pertinent to this project. Step three assessed faculty use of the bulletin board system and the main campus computer network by interviewing those responsible for each system. Step four evaluated faculty readiness to integrate multimedia technology into the learning environment by utilizing the CBAM Stages of Concern questionnaire (see Appendix J). In step five, a review of department action plans was conducted to identify goals and objectives pertinent to implementation of multimedia technology in the learning environment. Step six involved a review of the current strategic plan to identify planning priorities pertinent to this project. Step seven involved the review of internal data from the president's office to ascertain current and projected funding environment.

Assessment of External Environment

The external environmental assessment included eight activities seeking to identify external factors that might impact this project. They included (a) an assessment of local communications capacity and capability; (b) an assessment of current and planned technology use within the Northern and Eastern Maine Tech Prep Consortium; (c) an assessment of the use of multimedia at the University of Maine Presque Isle campus; (d) an evaluation of the status of multimedia efforts at New Hampshire Technical College at Berlin, New Hampshire and Springfield Technical Community College at Springfield, Massachusetts; (e) a review of the plan and goals of the Educational Consortium 2000 (ECO 2000) multimedia communications project; (f) a query via the COMCOLL list serve to identify other two year institutions working to implement multimedia into the learning environment; (g) an analysis of the state and federal budget climate via the news media and other publications; and (h) an assessment of state technology plans under development by the Maine State Department of Education.

The assessment of the local communications infrastructure available via local cable TV companies, NYNEX local phone service, and ITV services through the Community College of Maine was accomplished through several actions. Letters were sent to local cable TV vendors requesting information on their capability and interest in delivering distance learning activities (see Appendix K). The local NYNEX phone company representative was interviewed regarding the companies communications capability for distance learning delivery, and the ITV services available through the University of Maine were analyzed by reviewing the grant narrative for the Maine Project.

A survey of the Tech Prep consortium steering committee members was conducted to ascertain current and planned usage of multimedia at the secondary level (see Appendix L). Respondents were given the option to complete the survey via a phone interview or individually.

A review of the level of current or planned use of multimedia within the learning environment at University of Maine campus at Presque Isle was done through an interview with the campus technology director. This was the only campus within the seven campus system that was contacted because of its close proximity and potential for competition for the dwindling high school graduate population.

Springfield Technical Community College in Springfield, Massachusetts and New Hampshire Technical College in Berlin, New Hampshire were identified as two regional campuses having active multimedia programs. Dr. Doyle Davis of the New Hampshire Technical College System, and Dr. Georgena VanStrat of Springfield Technical Community College (MA), multimedia experts at their respective campuses, were contacted by mail to assess progress made with the implementation of multimedia technologies within the learning environment at their institutions (see Appendix M).

NMTC's internet connection was used to query community colleges on the COMMCOLL listserve concerning levels of multimedia usage within their respective learning environments. Contacts identified were contacted by e-mail, phone and via the U. S. mail for further information.

A review of the plans and goals of Educational Consortium (ECO) 2000, a local area school multimedia project was done by reviewing materials supplied and by interviewing the project leader. Related planning documents were also reviewed.

An assessment of state federal budgetary climate was done by reviewing public media articles and MTCS internal documents regarding the ongoing budget deliberations. Review of news media reports and professional journal accounts of the changing federal budgetary climate was also an ongoing activity during this project.

The Maine State Department of Education was contacted to determine what actions were occurring with the development of state technology plans. Phone calls were placed to the media services division and the state commissioner's office asking for the latest information concerning the development of a comprehensive state technology plan.

Plan Development Process

The planning activities conducted in this phase of the project sought input from within the institution and from external sources as well. Steps used in the planning process were adapted from Collins (1993) and included (a) reviewing data gathered, (b) listing of pertinent trends and issues, (c) creation of a vision statement, (d) determination of possible options, (e) a trade-offs analysis, (f) prioritizing preferred futures, (g) preparation of a draft plan for expert review, and (h) preparation of a long range plan.

The information gathered during the assessment process was used by the student author to identify trends and issues having potential to impact the future effectiveness of NMTC. Utilizing a process adapted from Lupica (in Olson & Parks, 1993), the data was reviewed by this author with a focus on (a) what trends and issues are represented by this collection of data? and (b) what related issues are represented by this collection of trends? The resulting list was arranged into two columns and grouped into six categories including (a) demographic, (b) economic, (c) educational, (d) legal-political, (e) competitors -- public and private, and (f) technological and occupational.

This author used the list of trends and issues to prepare an initial list of possible options-actions that might be taken to implement multimedia into the learning environment at NMTC. This list was divided into the three categories found in the technology-based learning paradigm discussed in chapter two including (a) knowledge-data base, (b) communications, and (c) learning management. Items in the knowledge-data base section were given a K prefix, those in the communications section a C prefix and those in the learning management section received an L prefix. The list presented to the management team also provided space for additional suggestions to be made by the team members if they desired. Based on the data gathered, a sample vision statement was also prepared for review and discussion by the NMTC management team.

These activities provided the basic information included in the initial project report to the NMTC management team. The report included (a) the problem statement, (b) the research questions, (c) an overview,

(d) the results of the literature review, (e) the results of the internal and external audit, (f) a tabular listing of trends and issues identified, (g) a sample vision statement, (h) the changing paradigms figure, (i) a list of possible actions-options developed by this author, and (j) a trade-offs analysis matrix to used as the tool to be used to prioritize the list of possible action - options. Figure 2 illustrates how this matrix was constructed for this project.

Constraints on Institutional Resources

	Low	Medium	High
Minimal	7 Fair Option	8	9 Best Option
Medium	4 Fair Option	5 Good Option	6 Good Option
Heavy	1 Poor Option	2	3 Fair Option

Optimizes Institutional Values

Figure 2. Trade-offs Analysis Matrix

Following a discussion of the report with this author, management team members were asked to once again review the suggested list of actions-options. They were instructed to use the trade-offs analysis matrix to prioritize the items listed. This was accomplished by placing the number for each item in the matrix grid that showed how individual members perceived the relative impact of each item on institutional values and institutional resources. At the end of one week all responses were returned and the average score for each item was calculated. A final matrix was prepared that showed the average value placed on each action-option by the management team members.

Once prioritized, list of possible actions-options was used by this author to develop related goals and objectives for each item listed. The resulting draft plan listed each action-option with its associated goal and objectives as well as suggested methods for achievement and evaluation of successful completion.

The preliminary plan draft and report, was sent to several outside experts for review and validation. These experts, who had previously consented to review and comment on the draft plan, included (a) Dr. Georgena Van Strat, Director of Multimedia Center at Springfield Technical Community College, (b) Dr. Wayne Mowatt, State of Maine Commissioner of Education, (c) Mr. Brian Hamel, Director, Loring

Development Authority, (d) Dr. Doyle Davis, System Fellow for Multimedia Development for the New Hampshire Technical College System, and (e) Mr. Terry Despres, Director of the ECO 2000 educational consortium and Superintendent of Schools S.A.D. #32 Ashland, Maine.

A cover letter was included to provide instructions for the review process (see Appendix P). The material included in the report included (a) the Changing Paradigms figure, (b) an introduction which provided an overview of the report including the three research questions asked in this project, (c) preliminary project findings which summarized the findings for questions one and two, (d) possible actions-options list, and (e) the findings for research question three, which included the vision statement and the draft goals and objectives.

Following replies from these experts, any major suggestions for revision or addition to the plan were made. The final plan format was adapted from Collins (1993) to include (a) each action-option and its associated goal(s) and supporting objectives to be achieved, (b) the methodology to be utilized to achieve each, and (c) the suggested evaluation method. This final draft version was provided to the management team members for review and feedback (see Appendix Q) prior to its presentation to the strategic planning committee. Following that feedback, the plan (see Appendix R) was presented to the NMTC strategic planning committee for inclusion in the committee's on-going planning activities.

Assumptions

Specifying the assumptions upon which a multi-year action plan is based is particularly important in any futures-based planning process. Seven assumptions were identified as being important to this Major Applied Research Project. First, it was assumed that the pace of technological change would increase. This would require an ongoing environmental scanning process to match NMTC's technological capacity to that of its service area and society in general. Second, careful planning would be necessary to insure effective utilization of new instructional technologies. A focused planning effort, based on an ongoing environmental scanning process, would be of primary importance in order to maximize the efficiency of technological innovation and utilization of existing funding resources. Third, instructional programs would increasingly employ new technology and course delivery/learning systems in the instructional process. Fourth, there would be increased opportunity and demand for distance learning delivery systems. New technology had the potential for enhancing the delivery of NMTC programs both on and off campus. Fifth, nontraditional instructional techniques and scheduling would see increased usage. Increased and efficient usage of educational technology would be utilized to meet the learning needs of an increasingly diverse student body both in time and type of learning experience. Sixth, availability of external grant funding would be imperative if quick implementation was to be accomplished. Seventh, proper utilization of the final plan would lead to a fundamental restructuring of the teaching/learning process at NMTC.

In addition four other assumptions stated by Ferrante et al. (1988) were found to also have a bearing on this project:

1. The computer is the most important invention of the 20th century and one of the central inventions in human history.

2. The move toward campus-wide networking and connectivity will accelerate and shortly be considered the standard for all institutions.

3. The goal in building computer systems on campuses is universal use by all members of an institution's community.

4. Postsecondary education shares responsibility with society to bring under control the power that knowledge provides to alter the environment.

Given the current funding environment, utilization of the final plan as a foundation for various grant writing endeavors is a must.

Limitations

The three primary limitations of this study were (a) the primary focus of the study was on NMTC and its service area, (b) success of the implementation of the multi-year action plan would be dependent upon funding resource availability, and (c) successful implementation would also depend upon the willingness of faculty to change instructional techniques and utilize new educational technology. The first limitation was that the development, implementation, and evaluation of this plan would be indigenous to NMTC and its primary service area. It was intended that generic educational technology, change effort, and evaluation practices would be tailored to meet NMTC service area needs. Second, implementation of the plan would be dependent upon identification of adequate funding resources. It was intended that this plan be used as a resource in several funding arenas. The third limitation centered on the change process necessary to convince faculty to change instructional techniques and utilize new educational technologies most effectively. It was anticipated that the human resources development component of the plan would be as important as hardware and software acquisition and require adequate time and funding resource support.

Chapter Four

RESULTS

This project resulted in a multiyear plan for the integration of multimedia techniques into the learning environment at NMTC and was accomplished in two stages (a) data gathering and, (b) plan development. This chapter explains how these two processes were accomplished and describes the final product of this project, the multiyear plan for the integration of multimedia into the learning environment at NMTC.

Data Gathering

This part of the project included an audit of the internal NMTC environment and an external environment assessment that provided an informational foundation for the planning process. These activities sought to identify current conditions, trends and issues pertinent to this project. Although the literature review yielded much information utilized in the final plan development process, the information it provided was not presented as part of this chapter.

Internal Audit

The following data were gathered through the use of the seven activities previously described in chapter three. They were considered to be indicators of the internal conditions pertinent to this project and are presented in the order listed in chapter three.

Current Multimedia Capability

In order to determine the current level of multimedia capability at NMTC, an inventory was conducted to determine the availability of equipment. The inventory revealed that of the 49 faculty on staff at the time of the inventory, 9 had 8086 based PC's, 22 had 286 based PC's, 4 had 386 based PC's, and 7 had 486 PC's readily available in their offices. The seven remaining faculty had no computers readily available. Computers accessible for student use included eleven 286 based machines, thirty-one 386 based machines, and twenty 486 based machines. These were found available in three computer labs and an open student writing lab. Since the inventory was conducted, two new computer labs with 20 new computers each have been added in the administrative assistant program. Thirty machines were also configured to access the internet. Other available equipment necessary for multimedia based learning included six VCR's, two videodisc players, 20 overhead projectors, 2 video cameras, and one digital still camera.

Faculty were also surveyed to determine the kinds of software they used and whether they used it regularly in support of administrative functions or in the classroom as a regular part of the learning experience. Forty-six faculty were sent a one page survey through the campus mail asking them to identify (a) the operating system regularly used, (b) software regularly used in an administrative capacity, and (c) software regularly used in the classroom environment. Thirty faculty responded to the survey (see Appendix I) which listed commonly used software found in each category, but left room for the addition of others not listed. Faculty were also asked to list software they felt they would use if it were available and to list the software they used regularly.

Operating system software usage reported by faculty included (a) DOS (17), (b) Windows 3.1 (14), (c) Windows `95 (3), and (d) OS2 (2). Software used in an administrative capacity included (a) grade book software (11), (b) data base software (3), (c) test preparation software (13), (d) desktop publishing (5), (e) presentation development software (11), (f) word processing software (16), (g) internet software (12), and (h) authoring software (0). Classroom uses included (a) remedial practice (3), (b) tutorials (6), (c) word processing software (10), (d) data base software (4), and (e) presentation development software (5).

Software listed by faculty as desired, but not available included Windows `95, Harvard Graphics, PAR system, presentation development software, interactive CD-ROM software, MicroSoft Office Professional, Word Perfect (5.1, 6.0 and 6.1), Versa-CAD, Data-CAD, Netscape, Macromedia Director, Adobe Illustrator, 3D Studio, Corel Draw, Page Maker and Animator Pro.

Regularly used software included Windows, A-write, Wordperfect, Quicken, Gradebook, MicroSoft Works, ETG Plus, Crossword Puzzle, Medication Programs, Diet analysis, EKG program, Print Shop Delux, P-spice, Lotus 123, ProWrite, First Publisher, internet, Harvard Graphics, MicroSoft Office, MicroSoft Word, MicroSoft Excel, MicroSoft Powerpoint. Various accounting and tax preparation software were also listed.

Strengths and Weaknesses

A review of the recently completed NEAS&C accreditation self-study report, completed in the spring of 1995, was done to identify strengths and weaknesses that might be a factor in the development of this planning project. Strengths listed in reference to institutional purpose, mission, and goals included (a) a strong strategic planning process that clearly articulates the mission, vision, goals, and objectives, (b) a growing relationship with area secondary and post-secondary institutions as evidenced by tech prep activities and articulation agreements, (c) a strong involvement in area economic development activities, (d) a strong commitment to continual employee development and training, and (f) a growing involvement with local business and industry with continuing ed and retraining activities. Weaknesses included (a) limitations on the degree offerings available to students, (b) limited financial resources, and (c) geographic isolation that limits exposure of students to a variety of different ethnic and minority role models and issues. This is viewed as a limiting factor in the global preparation of NMTC students.

In the area of finance, pertinent strengths included (a) NMTC enrollment had increased in the past 10 years, (b) NMTC's business and industry division was growing, and (c) the demand for NMTC programs and offerings remained high. Weaknesses included (a) a reliance on state funding and (b) the lack of ability to find alternative resources.

Pertinent faculty strengths identified included (a) a faculty committed to development of potential of all students, (b) a high level of academic preparedness and commitment to continuing professional development, and (c) a low faculty turn over rate. Weaknesses having a bearing on this project included (a) a significant decrease in professional development funds, and (b) lack of a multi-cultural faculty limiting the diversity of role models for students.

Strengths identified under the discussion of program of studies having bearing on this project included (a) a strong, dedicated faculty with high technical expertise; (b) a high faculty autonomy and flexibility in the design and implementation of programs to meet student, and business and industry needs; and (c) many courses offered at various locations and times. Pertinent weaknesses included (a) budget concerns, (b) students at off-campus sites not receiving appropriate prerequisite competencies for higher level courses, and (c) some off-campus adjunct faculty credentials not meeting accreditation standards.

The review of the library services identified the following pertinent strengths (a) an interlibrary fax network, the MaineCat system, the Maine Union List of Serials and the Infotrac system offer strong interlibrary loan capability within the state, (b) growing electronic reference capability, (c) patron access terminals ease the research function for students and faculty, (d) adjacent media center with available computers, printers, AV equipment, a copier, and (e) two internet terminals. Weaknesses included (a) limited seating capacity, and (b) low library budget.

Current BBS and AS400 Usage

Usage of the bulletin board service (BBS) instituted as part of the original tech prep initiative has been varied, but in general has served an important communication function. As internet capabilities have become available at different institutions the BBS is not utilized as much. It does still serve an important communications function with the public and other institutions. The AS400 central computer system installed with Title III funds does not get the use that was originally intended, but it serves a central administrative function within the student services department. Other administrative services are available (scheduling, e-mail, calendar, and others), but have not caught on with the majority of the faculty.

CBAM Stages of Concern Questionnaire Results

At a general employee meeting in April of 1995, members of the faculty and administration were asked to complete the CBAM Stages of Concern Questionnaire (see Appendix J). For this particular activity, the questionnaire was configured to focus on their perceptions pertaining to the use of multimedia techniques and technologies in the learning environment at Northern Maine Technical College.

Of the 55 surveys distributed to NMTC faculty and administration, 31 were returned resulting in a 56% total staff response rate. Academic department response rates included (a) Trade and Technical 9 out of 18 for 50%, (b) Nursing, 6 out of 8 for 66%, (c) Business Technology, 5 out of 12 for 42%, (d) General Education, 6 out of 11 for 55%, and (e) Administration, 5 out of 6 for 83%. The faculty response rate was 53%.

The average raw score on each questionnaire item was calculated for each department and the total staff. Each raw score was then compared to the quick scoring device found in Hord et al. (1987). This device contained a percentile scoring range for each of the seven stages of concern against which each raw score was compared to identify the percentile score it represented. When plotted, the percentile scores yielded a concerns profile (see Figure 3) indicative of the stages of concern each department had about the use of multimedia at NMTC.

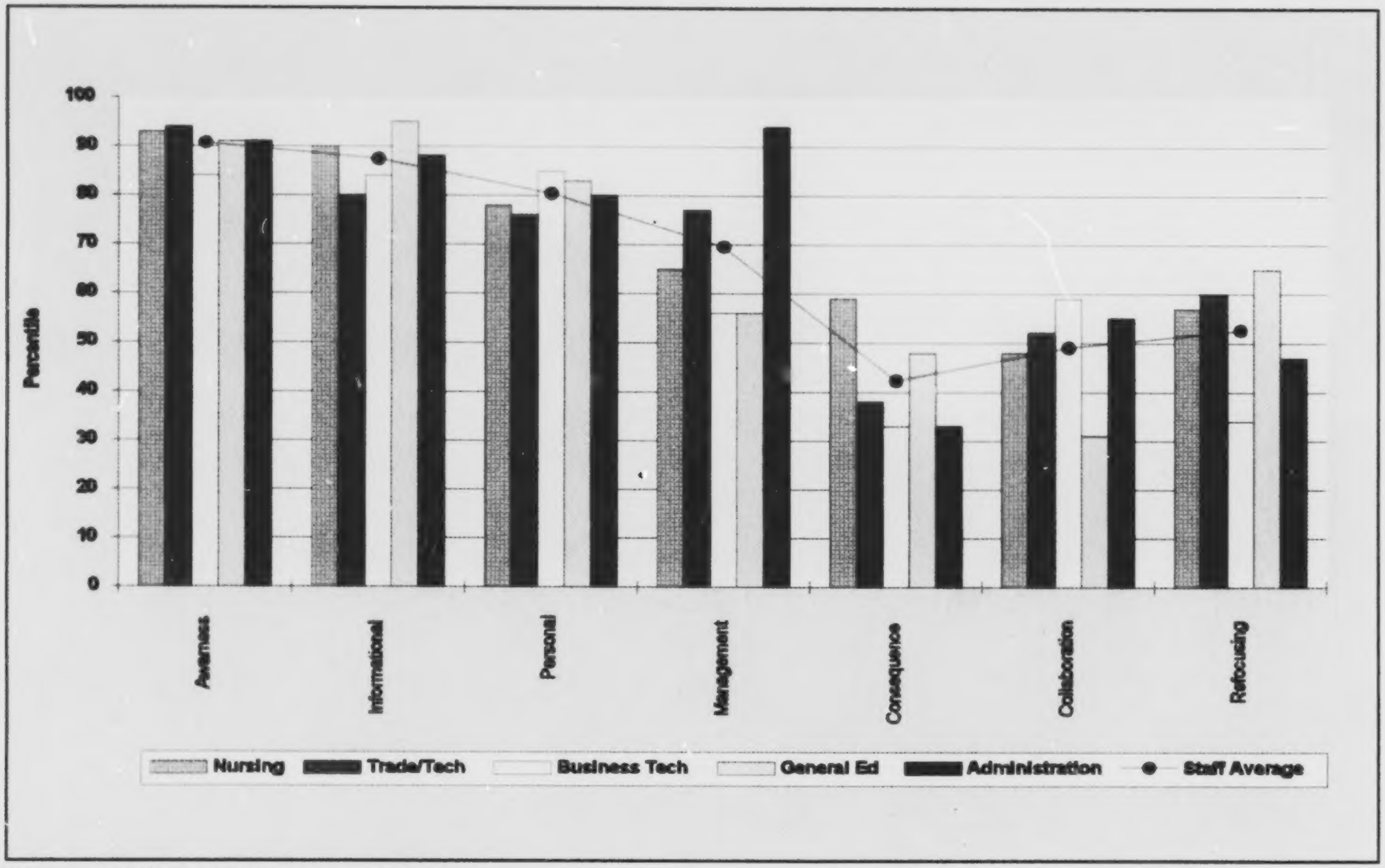

Figure 3. NMTC Staff Areas of Concern

Each profile yielded a graphic comparison of the levels of concern across the seven stages. In general, nonuser profiles are higher in stages 0,1, and 2, and lowest in stages 4,5, and 6 according to Hord et al. (1987). The results of the NMTC survey indicated greater levels on concern in stages 0,1, and 2 (91st, 87th, and 80th percentiles respectively) and lower concerns in stages 4,5, and 6 (42nd, 49th, and 52nd percentiles respectively). This closely resembles the nonuser profile previously described. The trade and technical faculty and the administrators also indicated higher concerns with stage 3, management.

Department Action Plans

At NMTC, department action plans play an important part in the strategic planning process. The action plans submitted by each department to the president's office were reviewed to determine the level of interest and action pertaining to integrating multimedia into the learning environment. The action plans of the general education department contained no goals pertinent to this project. It is not included in this data.

Business Technology Department

One business administration instructor's action plan included (a) writing a grant for multimedia, (b) training other business administration instructors in multimedia usage, (c) using on multimedia in course delivery, (d) researching the logistics of maintaining a distance education system, (e) designing local procedures to implement distance learning, (f) adapting syllabi to meet distance learning needs, and (g) delivering distance learning courses.

The computer applications instructor listed ongoing equipment replacement (four stations per year) as an ongoing part of his action plan. Also listed were (a) making all computers LAN and WAN capable, (b) updating application software, and (c) budgeting for equipment maintenance and replacement.

The office systems technology instructors included in their action plan (a) update of software, (b) increase internet training and use, (c) add network training and connections, (d) replace obsolete equipment, and (e) provide a learning environment that will enable students to interact with up-to-date technology that prepares them for new and developing careers.

Trade & Technical Department

Within this department the physics instructor planned to (a) utilize computers more frequently in the instructional process, (b) install a classroom computer network, and (c) add CAI capability to the physics and digital electronics courses. The diesel hydraulics program planned to promote computer based competencies through use in daily activities. Adding CAI was also listed by the computer electronics instructor.

Nursing Department

This department has set the goal to consult with the continuing education department to provide faculty training on computer software and multimedia applications. In particular, they were evaluating the ADAM anatomy and physiology software for possible use in the nursing program. Other institutions have adopted this program and eliminated the need for animal dissection in anatomy and physiology studies.

NMTC Strategic Plan

A review of the 1995 NMTC strategic plan did not identify any new aspects pertinent to this project. Pertinent aspects were listed in chapter one and are not repeated here.

Current Funding Environment

In the fall 1995 semester the general operating fund showed a $60,000 shortfall. Not filling three positions vacated due to retirement was done to cover the shortfall. Mid-semester financial figures showed an even greater deficit caused by 1400 hours of lost tuition revenue due to reduced enrollment. At the same time the governor asked all departments to deappropriate another 1.5% from the general operating budget due to lagging tax revenues.

Current funds available from alternative sources were limited. A Higher Education Act Title III Strengthening Institutions grant application was submitted in the spring of 1995 that described a project focusing on institutional research, outcomes assessment, and multimedia use in the learning environment. This project was not funded.

In the past Carl Perkins funds have also been a source of new equipment, but the addition of a seventh campus within the MTCS has further subdivided already dwindling funding resources. This has also resulted in the reduction of counseling services funded by these monies. With professional development funding now also dependent on Perkins funding, fewer development activities are receiving requested funding support. Other functions of the federal education effort are also slated for reduction or elimination including (a) Carl Perkins Vocational Act, student financial aid programs, vocational education programs and various grant programs under the auspices of the Department of Education.

Assessment of the External Environment

Because many factors external to an institution have a high impact on the planning function, several external factors previously identified as pertinent to this project were reviewed. They are arranged in the order they were listed in chapter three.

Local Communications Capability

In an attempt to ascertain the potential capability to deliver distance learning courses, a review of the capabilities of the local phone system and the local cable T.V. systems along with a review of the University of Maine ITV system was considered essential.

NYNEX - Local Phone Service

This data was gathered through an interview with the local NYNEX public relations representative on April 11, 1995. Current services available include the following:

1. 9600 Baud phone network,
2. distance dialing service vintage 2, 56 Kilobit Lottery network and 45 Kilobit service available,
3. bandwidth currently available for slow speed video -- 256 Kilobit in tandem,
4. video conferencing available -- PictureTel service, installation cost $14 - $50 thousand,
5. T - carrier service available at 1.5 Mbit/sec,
6. virtual ISDN currently available at home anywhere in Maine -- local true ISDN available within 2 years,
7. current infrastructure speed -- 1.2 Gigabit/sec,
8. asynchronous transfer mode switching in state possible in near future.

Even though the company representative stated the necessary technology was available and soon to be in place, the Educational

Consortium 2000 (ECO 2000) found NYNEX did not have the video handling capability needed to meet their transmission needs. They also found NYNEX not as cost effective as other providers.

Cable Providers

Letters of inquiry (see Appendix K) sent to the two local cable television vendors resulted in a response from only one. That vendor has recently been bought out by Time-Warner. Time-Warner had also expressed interest in being involved in the ECO 2000 project. Neither replied in writing. Two phone conversations with a local company representative from Time-Warner yielded a general picture of readiness to be involved in expanded communications and distance delivery systems. Much of the necessary infrastructure is currently in place. Distance delivery via the cable company would be possible by installing approximately 1.5 miles of fiber optic cable. A company representative promised written data showing current capability and renovations necessary to delivery distance learning via their infrastructure. However, the data promised has not yet been received.

The Maine Project

The Maine Project (Connick, 1995) is a telecommunications grant initiative developed under the auspices of the Education Network of Maine, a service of the University of Maine System.

The project consisted of five interrelated components (a) community (local and constituency) networking, (b) service applications, (c) education and training, (d) support and capacity building, and (e) evaluation. Implementation of the project under the auspices of the Educational Network of Maine would (a) implement and evaluate a combination of statewide communications networks, (b) seek to demonstrate cost effectiveness and flexibility of use, and (c) test models of public and private cooperation, pooling or resources, and support multiple uses of telecommunications systems.

Tech Prep Consortium Survey Results

Members of the Tech Prep Consortium steering board were surveyed to determine the level of technology use currently experienced by their students in the learning environment. Ten steering board members were sent a letter of explanation, a copy of the survey and additional information (Appendix L). Of the ten surveys sent out, seven were either returned via the mail or completed via phone interview yielding a 70% response rate.

The survey attempted to identify educational technology available for classroom use, internal and external connectivity, and other related technology issues. Table 1 summarizes the available technology listed by the respondents.

Table 1.

Available Technology - Tech Prep Consortium

School	Computers		VCR's	CD	T.V.	Video
	IBM/clone	Apple		ROM		disc
Houlton H.S.	60	21	10	7	27	0
Presque Isle H.S.	170	20	n/a	6	n/a	2
St. John Valley Tec. Ctr.	47	2	5	1	5	0
Cent. Aroostook H.S.	50					
Madawaska H.S.	60	3	n/a	28	25	1
Caribou H.S. & Tec. Ctr.	47- 386 2- 486		12	1	20	0
Fort Kent H. S.	80	2	9	5	35	3
SAD 33	91 8-486					

The responses indicated that IBM/clone computers were the main type used. Houlton and Presque Isle High Schools indicated they had 21 and 20 Apple computers respectively. Three other schools indicated having two or three Apple machines. Two schools indicated whether the IBM/clones were 386 or 486 machines. The data yielded by the rest did not identify the type of clone being used.

All schools indicated VCR's were available for use, but Presque Isle and Madawaska High Schools were not sure of the number. Houlton had nine, the Saint John Valley Technical Center had 5, Caribou High School had 9 and Fort Kent High School indicated that nine were available.

Although CD-ROM's were not as plentiful, each school had at least one. Houlton had 7, Presque Isle High had 6, the Saint John Valley Technology Center had 1, Madawaska High had 28, Caribou High School had 1, and Fort Kent High had 5.

Televisions were the most plentiful machines available at the schools surveyed. Except for the Saint John Valley Technology Center, which had five, the schools listed had 20 or more. Presque Isle did not have data on the number of T.V.'s available. Videodisc machines were not as prevalent as other technology. Only three schools indicated having this technology. Presque Isle High had two, Madawaska High had one, and Fort Kent High had three.

Table 2 summarizes the internal and external connectivity ability of institutions surveyed. This part of the survey sought to ascertain the level of internal and external connectivity available at each school. Four of the schools indicated that internet access was available, two were planning making it available and one indicated it would be available the next year. All had at least one computer network available.

Table 2.

Connectivity Capability - Tech Prep Consortium

	Internet Connection	Computer Networks	Computer Labs No.	Computer Labs PC's/lab
Houlton H.S.	yes	1	4	6 to 20
Presque Isle H.S.	yes	6	6	5 to 50
St. John Valley Tec. Ctr.	yes	1	2	16
Central Aroostook H.S.	planned	1	2	16
Madawaska H.S.	next year	3	3	20 ea.
Caribou Tec. Ctr. & H.S.	planned	1- Admin.	4	16 to 28
Fort Kent H.S.	yes	3	3	20

Schools with more than one included Presque Isle High with six, Madawaska High with three, and Fort Kent High with three. All schools had at least two computer labs. Six at Presque Isle High was the largest number reported. The numbers of PC's per lab ranged from a low of five to a high of 50 with most in the 16 to 20 range.

All but three schools indicated that the labs were utilized in multiple programs. Only one, the St. John Valley Technology Center, indicated that each faculty had a computer. Two others indicated that they were available upon request. The most common uses of computers identified were those committed to drill and practice, administrative, and CAI lessons and other learning activities.

Five of the schools used multimedia applications in the classroom, but only one used them as the primary delivery device. Only one other produced the presentations on-site, giving the indication that professionally prepared applications were the primary choice. Commonly used software applications listed included Lotus, Word perfect, Dbase IV, CA I&II, MicroSoft Word, Pascal, MicroSoft Office Pro (system-wide) and Power Point. One interesting side note is the fact that Madawaska High School runs its own T.V. station through the local cable company and uses it as the foundation for its public communications course.

Barriers to integration or implementation of multimedia technologies listed by the respondents included (a) lack of financial resources, (b) lack of trained staff, (c) lack of faculty inservice, (d) up-to-date equipment, and (e) lack of faculty time or incentive. On-site technical support available ranged from limited to readily available.

Two schools, Madawaska and Fort Kent, had well developed technology plans. The rest were in various stages of development.

Equipment and software expenditures were also varied. Fort Kent has just entered into a five year $300,000 lease, and one other school had $2,100 budgeted. Software expenditures budgeted included $500, $8,000, and $4,000. Four schools were budgeting no hardware expenditures and three no software expenditures.

Staff training was done mostly through informal one-on-one mentoring, through the adult education function, and through some school based inservice training provided by external expertise. Limited resources were the main barriers to increased staff training.

A major concern listed by most was maintaining technical currency. In one example a school said it had two windows compatible computers in its computer lab. It had no money for upgrades in the last three years and none was projected for the next year. 75% of their current machines were 8088's and over seven years old.

Multimedia Usage - University of Maine at Presque Isle (UMPI)

An interview with the campus technology director yielded the following information. Currently there is no vision or integrated plan for educational technology on the Presque Isle campus of the University of Maine. A recently completed Higher Education Act Title III Strengthening Institutions grant provided funds to equip all faculty with computer equipment, but little professional development support for training in their use was offered. Efforts were being made to find funds to upgrade faculty computers to the Windows operating system.

A technology committee has been formed to begin the planning for technology usage at UMPI. Involvement with the American Association of Higher Education (AAHE) and its Teaching, Learning, Technology Roundtable may be part of this effort.

Multimedia Usage - Springfield Technical Community College (STCC)

A letter to the director of the multimedia enhancement project (Appendix M) yielded the following information concerning the use of multimedia at STCC. STCC in Springfield, Massachusetts had just finished a five year Higher Education Act Title III Strengthening Institutions Grant entitled, Multimedia Instructional Enhancement Project. The following results occurred during the project:

1. Six multimedia delivery platforms (four mobile and two stationary) were purchased to support teacher-centered presentations.

2. A multimedia center was established and adequately equipped to assist faculty in multimedia development.

3. Twenty-five faculty were trained in the design and delivery of multimedia based instruction.

4. Eleven developmental courses were originally developed followed later by 11 other multimedia enhanced courses.

5. Faculty and students were very excited about multimedia tools used to enhance classroom environment.

6. Student response was overwhelmingly positive as evidenced by increased classroom participation, higher test scores, increased motivation, and improved note taking.

Initially STTC underestimated (a) the initial hardware and software costs, (b) dedicated classroom needs, (c) staff needs, and (d) the scheduling demand for dedicated space. There was also an initial lack of understanding of the large amount of time required to research and purchase the right hardware and software. The major drawback identified was the amount of faculty time required to produce a finished product. Early on it was found that faculty did not readily adapt to professionally prepared presentations. Following the purchase of authoring software and subsequent training, all programs are now authored on-site.

Multimedia Usage - New Hampshire Technical College System (NHTCS)

The NHTCS was also identified through various media as being a leader in the implementation of multimedia in the learning environment. A letter was written to Dr. Doyle Davis seeking information on the development process used, current progress being made, barriers to progress, and plans for the future.

The development of multimedia applications and a changed pedagogy within the New Hampshire Technical College System (NHTCS) began in 1992 with a $100,000 and the appointment of an expert in technology- based pedagogy as the system fellow for pedagogy. Volunteers at each of the campuses invested six to seven weeks of summer vacation in the initial phase of the project. The system fellow visited each campus once a week and provided a two hour training session.

Since the inception of the project over 50 teachers have been given training. Out of this group, only 5 of 6 have actually developed self-paced lessons which are used by students, over 300 system faculty have experienced multimedia presentations and workshops. Each school has begun to acquire multimedia hardware and are at various stages of implementing multimedia into their programs. Increased requests for training are occurring as the use of these new technologies begins to spread.

Dr. Davis listed the following three pointers to keep in mind:

1. Keep your training sessions short. It is better to learn a few things well at each session than overwhelm them with too much at once.

2. Choose an authoring system with cross-platform capability such as Authorware Pro, and Macromedia Director. This will allow any lessons developed to be played on any type of computer.

3. Involve a wide group of faculty, not just arts and sciences, but people from many disciplines.

Dr. Davis identifies two major barriers:

1. Time and energy are required to develop lessons.
2. People are resistant to change.

ECO 2000

This collaborative partnership comprising six rural northern Maine public school districts, local higher education institutions, government, and industry has been formed to promote distance learning opportunities. Partnership members include: (a) School Administrative District (S.A.D.) #24, (b) the Easton School Department, (c) S.A.D. #33, (d) S.A.D. #32, (e) S.A.D. #45, (f) School Union #122, (g) Northern Maine Technical College, (h) University of Maine at Fort Kent, (i) University of Maine at Presque Isle, (j) Maine Department of Education, (k) Maine Department of Human Services, (l) Maine Department of Corrections, (m) New England Bell, (n) McCains Corporation, and (o) JM Huber Corporation.

The partnership is working to establish a comprehensive distance learning system referred to as the Northern Maine Academic Link (NORMAL). This link will provide distance learning delivery of educational services currently not able to be provided regularly by the member schools. Plans also include major infrastructure development within each member school. Internet access is available and faculty training is under way.

S.A.D. #32 has acquired the former USAF Radar Training facility in Ashland, Maine for one dollar and will utilize the site as the media hub for the ECO 2000 NORMAL network. Currently ECO 2000 has a commitment from Time-Warner Corporation to install a 144 fiber optic link and maintain it free for 20 years. All it requires is the use of four of the available fibers to deliver its services. ECO 2000 is now looking for $2.6 million to purchase the necessary cable and equipment.

Alpha Five

Alpha Five is a similar partnership to ECO 2000 now in the formation stage. It includes the larger school districts in the area including Caribou, Fort Fairfield, Presque Isle, Mars Hill, and Houlton school districts. The Micmac Native American health clinic, two regional hospitals, and community access are also included. They will link with the ECO 2000 hub and are also a partner in the Maine Project.

Listserve Results

On Friday, April 21 the following message was sent to Commcoll listserve members: "My name is Terry Overlock, science and electronics instructor at Northern Maine Technical College. I am interested in identifying community colleges that are leaders in the integration of multimedia technology into the learning environment. If you know of such institutions, please leave the name and address of a person I might contact for further information." Over the next week I received suggestions for ten different possible contacts. Only one produced any information. An institution had just completed its first year of a Title III grant focusing on integrating multimedia into the learning environment. Using the information provided by the contact person, the complete Title III document was down loaded via modem connection between NMTC and the host institution. Other contacts did not yielded any results of any use to this project.

State and Federal Budget

State Budget

Internal data provided by the NMTC presidents office yielded the following information. Funding from state revenues has not kept pace with inflation in recent years. Although state funding support increased by 2.79% in 1991, inflation increased 4.2%. The 1992 state funding support increased by 8.29% exceeding the inflation rate by 5%. However, 1993 and 1994 yielded reductions of 3.25% and 1.4% respectively while inflation increased by 3.3% and 2.5% during the same period. The governor asked all departments to submit two budgets for the next biennium, one that was essentially flat funded and another that showed "substantial" reductions. This was the result of the current projected state budget shortfall for the next biennium of over $375,000,000.

The final budget approved by the legislature resulted in an increase of $3.5 million over the next two years. This is $2.5 million less than the projected amount needed to maintain current levels of service. Major cuts were also made in the Maine Quality Centers Program and $4.5 million was cut from state-funded job training programs over the next two year. A tuition increase from $58 to $61 per credit hour was approved by the board of trustees. These trends have resulted in increased costs to students. Since 1989, dorm rental has increased from $700 to $1,100 per semester. In-state tuition has risen from $33 per credit hour to the recently approved $61 per credit hour.

Federal Budget

The budgetary climate at the federal level is even more uncertain at this time. With deficit reduction a major goal of the republicans, major cuts in federal programs can be expected. The senate has approved a Supplemental Appropriations Bill for FY 1995 that contains sharp reductions in Department of Education programs- including $52 million in cuts for vocational education (Hudelson, 1995).

State Technology Plans

A phone call to the Maine State Department of Education, Library Services Division yielded the following information about technology planning at the state level. The recently completed Maine Goals 2000

Statewide Education Technology Plan (Center for Educational Leadership and Technology, 1995, p. viii) lists seven major recommendations to guide educational planners:

1. Technology should be used throughout the curriculum as a tool in the hands of learners in order to maximize their learning potential.
2. Educators must be provided with the training, equipment, time, and on-going support to enable them to use technology in their work.
3. Assure that all learners have equitable access to technology, facilities, and training.
4. Develop a technology architecture identifying minimum technical standards for building construction and/or renovation, equipment, support personnel, system/network compatibility and interoperability.
5. State, district and school administrators will take leadership roles in bringing technology into Maine's education system.
6. Funding for technology and its application must be an essential priority at the state and local levels.
7. Local education agencies are responsible for comprehensive technology planning.

Plan Development Process

This aspect of the project focused on identifying the important actions that should be included in a plan for the integration of multimedia into the learning environment at NTMC. The activities involved in this process included (a) a data review, (b) listing of pertinent trends and related issues, (c) creation of a vision statement, (d) identification of possible actions-options to be undertaken, (d) a trade-offs analysis, (e) preparation of a draft plan for expert review and validation, and (h) preparation of a multiyear plan.

Trends and Related Issues Identified

The data gathered during this project was reviewed and analyzed by the student author to identify trends and related issues having a bearing on this project. This review and analysis resulted in six lists of trends and related (see Appendix N) issues being identified. Each list was labeled with one of the six categories listed in chapter three including (a) demographic, (b) economic, (c) educational, (d) legal-political, (e) competitors - public and private, and (f) technological and occupational. They were included in the initiial project report and in the final report to the strategic planning committee to provide a context for planning.

Possible Actions-Options

Following the identification of the trends and related issues pertinent to this project, this author developed a list of possible actions-options that might be used to guide the remainder of the plan development process. The actions-options identified were grouped into the three sections of the technology-based learning environment (a) knowledge/data base, (b) communications, and (c) learning management. See Appendix P for the complete list.

Trade-offs Analysis

The previously described planning process progressed with only minor variations. A report was presented to each member of the NMTC management team for their review and comment. The report included (a) the problem statement, (b) an overview of the report contents, (c) the project research questions, (d) literature review, (e) internal audit results, (f) external analysis results, (g) trends and related issues previously listed in this chapter, (h) sample vision statement, (i) changing paradigms model, (j) a list of possible options-actions, and (k) a trade-offs analysis matrix with directions for its use.

Members were asked to review the options-actions list and use the trade-offs analysis matrix (as described in chapter 3) to indicate their perceptions of each item's impact on institutional resources versus how each optimized institutional values. At the end of the two week period only one of the trade-offs matrices had been completed. It was decided at that time that the project leader would meet as planned with the management team and discuss the report with team members to facilitate the completion of the trade-offs analysis and the vision statement.

Subsequent to the discussion of the report findings, individual management team members were given a week to decide how they would prioritize each item by placing each number in the appropriate cell in the trade-offs matrix. Final priorities were set directly from results of the trade-offs analysis process previously described in chapter three. The results of the management team's trade-offs analysis are plotted in Figure 4.

Constraints on Institutional Resources	Low	Medium	High
Minimal	7 K3, C6, C9, C12 Fair Option	8	9 Best Option
Medium	4 C1, C4, C7, K2, C11, L4 Fair Option	5 C2, L1, L2, L5, L7, L8 Good Option	6 Good Option
Heavy	1 Poor Option	2 C5, C8	3 K1, C3, C10, L3, L6 Fair Option

Optimizes Institutional Values

Figure 4. Final Results of Trade-Offs Analysis Matrix

External Review and Comment

A prioritized list of possible options-actions with related goals and objectives was developed from the results of the trade-offs analysis. This resulted in the preliminary draft plan, report and cover letter (Appendix P), which was sent to several outside experts for review and comment. These experts, who had previously consented to review and comment on the draft plan, included (a) Dr. Georgena Van Strat, Director of Multimedia Center at Springfield Technical Community College, (b) Dr. Wayne Mowatt, State of Maine Commissioner of Education, (c) Mr. Brian Hamel, Director, Loring Development Authority, (d) Dr. Doyle Davis, System Fellow for Multimedia Development for the New Hampshire Technical College System, and (e) Mr. Terry Despres, Director of the ECO 2000 communication consortium.

Four of these people were able to provide feedback and comment on the draft plan provided for their review. Working from a business perspective, Mr. Hamel contributed the following comments:

1. Utilization of computer technology is very important but is a means, not an end. "Computer technology is not a replacement for common sense, practicality, personality, and work ethic."

2. A cost/benefit analysis should be performed and a shorter list of goals and measurable benchmarks be prepared.

3. Don't underestimate the "buy in time" required for these changes to be made. He felt that time projections in the draft plan were "extremely aggressive".

4. He agreed that the pitfalls listed (Moursund, in Roth et al., 1990) were very real and need to be addressed prior to selling the package to anyone.

Dr. Doyle Davis, multimedia trainer for the New Hampshire Technical College System contributed comments from an educational perspective. Dr. Davis chose what he considered to be priority items in each of the three sections of the draft plan report.

Dr. Davis was in full agreement with the priorities set in the knowledge-data base portion of the draft plan with promotion of the use of electronic knowledge-data base in all classes as the number one priority and development of a centralized data base accessible by all faculty, students, and administrators as priority number two. He commented, "A facility with the ability to provide internet access, serve up data streams from CD-ROM, laser videodiscs, VCR's, tape, and satellite programs is something you really need to try to establish (D. Davis, personal communication, September 7, 1995)."

Within the communication portion of the plan he disagreed with the priorities set. He felt it was first important to develop the campus-wide fiber-optic infrastructure (with at least one drop and a terminal in each classroom) mentioned in preferred action-option C1 and then follow up with C6, promotion of the use of the internet in regular classroom activities.

His response to priorities set in the draft plan for the learning management also differed slightly from those in the draft plan and echoed many of the themes and ideas previously discussed in this project. He commented:

> I truly believe that these new technologies i.e. the use to the internet with the World Wide Web; authoring systems which are easy to learn and use; and digital video technologies are providing teachers now the ability to restructure the way they teach and provide new ways for students to learn. I feel that the standard teaching method used by most of us i.e. lecturing is a passive way of teaching. More active forms of learning need to be introduced. I am not saying that we should abandon entirely the lecture method -- it does have its purpose sometimes. However, I think those schools which will survive economically and academically in the next century will be those that can provide students individualized, self-paced, open-entry open-exit learning environments. More and more we will find adults returning to our technical colleges for retraining. We need to be able to rapidly access their skill level and let them jump in at any point in a program of instruction. If the method of program delivery is developed which permits such individualized instruction, we will be in a better position to meet this growing retraining need. (Davis, personal communication, Sept. 7, 1995)

Dr. Davis also made several supportive comments in regard to the assumptions upon which the plan was based. In regard to the proposed hardware list, he suggested the following changes: (a) replace the

Pentium 90 Mhz CPU with the Pentium 133 Mhz, (b) increase the 16 Meg of RAM to 24 Meg of RAM, (c) replace the triple speed CD-ROM with a quad speed device, (d) replace the 800 Meg hard disk with a 2 - 4 Gigabyte device, and (e) replace the 14.4 Kbaud modem with a 28.8 Kbaud device. Developing mobile multimedia carts was also strongly suggested.

Commenting on the planning issues and reminders listed in the draft plan report, he noted the importance of involving faculty and staff continually in the planning process and considered training all users as a continuous, centralized function with the proper budgetary support was a must. His final comment: "Excellent plan! Best wishes to everyone at NMTC for its implementation." Suggested additions to the methods and evaluation processes were incorporated in the final plan.

Two other members of the expert panel had short, but supportive comments. Mr. Wayne Mowatt, Commissioner of Education for Maine, sent the following comment: "This looks fine - you did a great job. Good luck on your project." Mr. Terry Despres, Director of ECO 2000 felt that the plan was on target and contained the appropriate goals to help move the NMTC learning environment toward a technology-based paradigm. He did feel, however, that resources (human and monetary) would play a major role in the degree of success of the plan.

Final Report

The draft version of the multiyear plan for the integration of multimedia into the learning environment at NMTC was revised to include the suggestions made by outside reviewers. Their comments were also summarized in the project report. This final version was combined with a project report which consisted of (a) an introduction that included the problem statement, significant factors, and the research questions; (b) a description of the data gathering process that included a summary of the literature review, the internal audit results, and the external analysis data previously included in this chapter; (c) a description of the plan development process used; (d) the final version of the multiyear plan complete with goals, objectives, implementation methods, and evaluation methods; and (e) a complete bibliography of sources utilized in this project.

At this stage of development, the project report was given to each of the management team members for final review and comment prior to its being presented to the strategic planning committee. Acting on behalf of the NMTC management team, the college president thanked the author for his efforts in this project and stated: "The work which you have done can be most valuable to Northern Maine Technical College as we continue our journey 'toward excellence' in the use of multimedia to enhance the learning environment" (see Appendix Q). Following this review by the management team the final plan was disseminated to the members of the strategic planning team.

Multiyear Plan For The Integration of Multimedia The Learning Environment At NMTC

As previously described, the goals of the multiyear plan were arranged in the three categories of the technology-based paradigm (a) knowledge-data base, (b) communications, and (c) learning management. Each goal was preceded by the action-option it was developed from to provide a context for that goal. In each of the first two categories every goal was developed from one of the original action-options listed. In the learning management category goals were developed from only two of the preferred action-options. One goal was developed from action-option L (utilize the computer for all routine classroom administrative needs) and two goals were developed from action-option L1 (faculty utilize multimedia to supplement and/or enhance teaching methods). The other original action-options in the learning management category were implemented as objectives in support of these goals.

The goals were arranged in priority order based on the previous trade-offs analysis and expert review processes. Each goal was accompanied by a series of supporting objectives, which identified specific actions to be taken and a date for completion. Each objective was supported by several suggested methods for action. These were followed by several suggested methods for evaluation of the degree to which each objective was completed.

The 1995 NMTC Strategic Plan format also listed managerial oversight responsibility and a proposed budget allocation for each objective. Therefore these two items were also included with each objective. Blank lines were inserted with each to allow the insertion of names and budget allocation when identified.

Goals Listed In The Plan

Knowledge-Data Base Goals

1. All NMTC faculty and students will routinely utilize available electronic knowledge-data bases in their classes.

2. NMTC will implement a centralized electronic database resource with on-line access available to all of the campus community.

Communication Goals

1. Internet resources will be made readily available and used regularly in the learning environment at NMTC.

2. The entire NMTC campus community will be connected to a campus-wide network accessible from internal campus locations and external locations.

3. All members of the NMTC community will have on-line access to internal and external electronic data sources readily available from their office, department, or other convenient location whether internal or external to the campus.

4. All faculty and students will have ready access to the latest multimedia computer equipment and software.

5. NMTC faculty will have ready access to mobile multimedia equipment from which to prepare and present multimedia presentations.

6. NMTC will install at least one networked computer lab per academic department and increase the number of open computer labs available for student practice, research, and CAI.

7. Students in programs with heavy computer usage will purchase a laptop computer upon enrollment in the program

8. NMTC will expand the learning environment for current and future students by developing the capability to deliver some courses via the distance communication technologies most appropriate.

Learning Management Goals

1. The majority of all classroom administrative requirements will be accomplished by computer.

2. NMTC faculty will routinely use multimedia applications for course development and presentation.

3. All faculty will have complete access to the necessary multimedia equipment in a faculty resource center and in their respective departments for the design and presentation of instructional materials.

Sample From The Plan

The following is a sample goal and associated objective taken from the plan. It is provided to give a clear indication of the format used for presentation of the various items included in the final plan.

1. Preferred action-option K3 – Promote the use of electronic knowledge-data bases in all classes.

Goal: All NMTC faculty and students will routinely utilize available electronic knowledge-databases in their classes.

Objective 1. The library will annually provide a listing of electronic data base resources available to the campus community.

Methodology: Library personnel will provide short training sessions for faculty and students each semester.

Methodology: Library personnel will produce a brochure listing available electronic database resources in the library.

Methodology: A quarterly newsletter from the library providing updates.

Evaluation: Maintain record of training sessions

Maintain record of publications done by library

Evaluation: Keep a log of how many use the training they have received.

Responsibility: ____________________________

Budget Allocation: _________________________

Objective 2. By September 1998, all NMTC faculty will include a list of electronic database resources in their respective course syllabi.

Methodology: Guidelines for course syllabi will describe the necessary inclusions for adequate student information.

Methodology: Develop a homepage where all course syllabi can be accessed by students on-line.

Evaluation: All course syllabi reviewed for listing of electronic data resources available.

Evaluation: Feedback from students concerning the degree to which they are asked to use data resources in their course work.

The plan is presented in its entirety in Appendix R.

Chapter Five

DISCUSSION, CONCLUSIONS, IMPLICATIONS, AND RECOMMENDATIONS

Discussion

The completion of this MARP project resulted in a comprehensive plan for the integration of multimedia technologies into the learning environment at NMTC. Even though the initial objective of this project was to develop a plan for the integration of multimedia into the learning environment at NMTC, it soon became evident that the potential for positive change resulting from multimedia use in the learning environment was closely linked to other aspects of a technology-based learning environment. There was (and continues to be) a growing discussion of fundamental change in the learning environment supported by rapid changes in educational technology and societal expectations.

This necessitated a broader view of information technology in the learning environment, and resulted in a vision of change from the current teacher-centered paradigm to the student-centered, technology-based paradigm discussed in chapter two. The three major aspects of this paradigm, the knowledge-database, communications, and learning management became the three major segments of the framework around which the resulting plan was fashioned.

Hardware and Software Availability

Although the term multimedia means different things to different people, Hofstetter's (1995) definition provided the real foundation by which to evaluate the level of multimedia capability. By his definition, a true multimedia system includes a computer to present and combine text, graphics, video and audio with links and tools that let the user navigate, interact, create, and communicate. If one aspect is missing, true multimedia does not exist.

At NMTC, the internal equipment and software use surveys revealed large gaps in the necessary list of equipment for true multimedia to exist. Many of the existing computers were not of sufficient capability to handle the complex functions demanded by multimedia activities. There was also a lack of sufficient video and audio equipment for such a system. The analysis of some of the Tech Prep Consortium schools and UMPI revealed much the same picture.

Although the multimedia hardware listed by Hofstetter in chapter two was considered to be necessary for a top of the line multimedia system, when this project began much of it has already been replaced by newer technology. Rapid change in technology is, and will continue to be, a major factor to be dealt with in the emerging technology-based learning environment. While some segments of this list may change in the near future, it still can serve as a standard against which NMTC, and other institutions, can measure their multimedia readiness and capability.

Software is the other necessary component of a multimedia system. Without it the hardware in next to useless (Dahmer, 1993). The four types of software identified by Dahmer (1993) include (a) operating systems, (b) system-interface software, (c) authoring systems, and (d) courseware. The internal software use survey revealed three basic operating systems in use with a fourth just beginning to appear. Although some of the faculty at NMTC indicated use of software in the classroom as part of the regular learning environment, most of these were software used in the occupational environment (drafting, word processing, spread sheets, and data base software). Most of the faculty responding to the survey indicated several types of software in use to support classroom administrative needs. Authoring systems and interactive courseware need a level of equipment sophistication not currently available at NMTC and is probably the reason that no faculty listed them on their use surveys. This should be used as an indicator to planners that the hardware tools must be in place before authoring systems and interactive courseware are implemented at NMTC.

The rate at which the equipment listed in chapter two has begun to be replaced by newer technology just during the course of this project underscores the problem of technological obsolescence. The rate of technological change has compounded the problem of technological obsolescence. As the pace of technological change has increased, the resulting useful life of computer equipment has decreased. The current useful life (Green, 1995) of computer systems is 24 to 30 months and software 12 to 16 months. Technological obsolescence (Green, 1995) is a structural component of technology-driven change and should be met with budgetary processes that include capitalization and amortization plans for multimedia equipment purchases. Green (1995, p. 54) states:

> Technology is no longer a new phenomenon for colleges and universities: it is now a key component on the infrastructure, central (and increasingly essential) to the instructional activities and scholarly mission of all types of institutions and across all disciplines.

However, as is the case with many institutions, much of the technology funding at NMTC has been provided by alternative funding means and has therefore been sporadic. This has resulted in the current mix of largely out-of-date faculty computer equipment and a general lack of multimedia hardware. Green (1995) suggests institutions develop a 3-5 year amortization plan and include purchase funding in the regular operating budget of the institution instead of depending upon alternative or surplus funding as is so often done presently. It would appear that NMTC must work toward developing this type of funding process for educational technology if it wishes to remain in the forefront of the technology-based metamorphosis occurring within higher education.

This obsolescence problem places a greater burden on faculty to remain up-to-date not only in hardware expertise but also to be conversant with the latest software offerings. The sophistication of software capability is rapidly growing providing educators with a cornucopia of interesting and valuable multimedia software from which to chose. This increased choice, however, also adds to faculty's burden to remain technologically current in a time of rapid change. It also increases the need for institutions to ensure adequate HRD funding resources to facilitate up-to-date faculty technology skills.

One may choose either professionally prepared presentations or the software to develop them. Several professionally prepared, subject specific programs are available. Heading this list of presentation preparation software are the growing number of course authoring software packages currently available. Choosing one may be a bit of a challenge because one will have to weight the cost and ease of use with the faculty training necessary for its effective use in the learning environment. The number of presentation preparation and desktop publishing software packages available is also on the increase and should be included in the mix of software tools used to enhance the learning experience at NMTC. Cross-platform software capability also becomes increasingly important (Davis, personal communication, 1995) as all parts of the learning environment become networked and as faculty and staff travel to make presentations at other locations.

The Future for Campus-Based and Distance Learning Systems

Campus-Based Systems

Several important trends were identified during this project and indicated many changes ahead for campus-based learning environments and distance education networks. All point to a future of rapid, on-going change providing both opportunity and threat. The opportunity and the need exists for the development of a student centered, technology-based learning environment at NMTC.

Although it is clear that all the necessary technology to offer true student-centered, technology-based learning is not currently available at NMTC the interest is there. Several faculty have indicated interest to begin this transition in their action plans. This coupled with the CBAM questionnaire results indicating a general need for more information should provide a solid planning foundation for the allocation of resources for the HRD function at NMTC. The importance of this function will increase as NMTC strives to remain competitive with the growing list of institutions who are developing a technology-based learning environment.

The CBAM questionnaire, used in this project, should continue to be utilized to evaluate the faculty's levels of concern as this evolution toward the technology-based learning environment continues. The results should be used as a foundation for planning HRD programs from which to begin the change effort and assess progress made with that effort. This information coupled with NMTC's professional development program should provide the means to maximize the potential of the scarce professional development funds currently available.

As technological change speeds up, the human factor will become an increasing concern for NMTC leadership. Dealing with change and developing the ability to be lifelong learners are skills that future occupational survival will demand. Education is no different. To cope with the changes being thrust upon it, NMTC must develop a more refined and ongoing professional development function. Brown (1995, p. 2) says: "As technological advances continue--and even speeds up--it is likely that more and more people with hard-earned skills of the moment will become marginally useful as new skills replace them." For educators, staying informed about changes in multimedia is also a matter of personal and professional necessity (Hofstetter, 1995) because. . . " the ability to use it is emerging as a life skill, [and] you will continually need to develop your multimedia techniques to stay competitive in your profession and live fully in the information society" (p. 183). Maintaining this expertise will have to be a major focus of HRD efforts at NMTC if it is to remain competitive in its offerings.

A major influence of the rapid development of the technological society is that of on-going, rapid change and its effects on occupational skills. New foundation skills are emerging and must be incorporated into the learning experience at NMTC including (a) the ability to access information, (b) to interpret it, (c) to apply it, and (d) to use it to solve problems and work collaboratively with others. These skills combined with occupationally specific training will enable NMTC to empower its students to be competitive within their occupation and provide them with the lifelong learning skills necessary for economic survival in a technological society.

Proper planning functions must be utilized if technology is to achieve its maximum potential for beneficial change in the learning environment. Kirby (1994) advises the use of well developed technology plans to overcome the problems caused by willy-nilly purchase of equipment. Not only must the process be highly participatory, as is NMTC's, but it must be supported by a strong environmental scanning process (Ferrante, et al., 1988). This project revealed that the data gathering process used lacked an organized, routine effort. This may be one of the reasons that this project yielded a more indepth approach to integrating multimedia into the learning environment than the 1995 strategic plan which provided the original impetus for this project.

The fundamental issue for any technology plan (Roth, Gooler, Teslowski & Winters, 1990) is how these technologies will actually improve teaching and learning opportunities without creating other problems. The major goals of any technology plan (Dively, in Roth et al., 1990) should include (a) increased access to learning opportunities and (b) increased student achievement and learning efficiency. These are the benchmarks that the NMTC strategic planning committee should use as it prepares to implement this plan.

Technology is rapidly becoming a more important institutional foundation than bricks and mortar, and is much cheaper. It is becoming the standard by which students compare institutions, and promises to be a growing factor in accreditation standards. The old competitive reference points of bricks and mortar are being replaced by

> . . . information resources and tools available as reflected by a) the number of locations on and adjacent to campus, that support mobile computing and network access; and b) the kinds, quality, and currency of digital resources available on line via the campus library or information services center. (Green & Gilbert, 1995, p. 12)

This provides a valuable standard by which NMTC might assess its ability to meet student needs and determine how competitive it is with other education and training providers at all levels as the technology-based learning environment continues to evolve.

The new communication technologies also offer much potential to assist higher education to address the issues of funding, accountability, cost effectiveness, access, and equity currently being debated. One of the weaknesses listed in the recent NEAS&C Self-Study Report pointed out a problem with students at satellite locations not developing the necessary foundation skills in some course offerings. Problems with adjunct faculty credentialing were also listed. The solution to these problems may come in the form of technology-based distance or distributed learning experiences guided by fulltime faculty instead of adjunct faculty lacking experience or credentials. Delivering courses for advance standing to students in the Northern and Eastern Maine Tech Prep Consortium may also be an option to consider. Wise use of new technology will give NMTC staff the potential to deal with these issues.

Technological change is also fostering rapid occupational change, which is creating an environment of rapid curricula change in both structure and content. New foundation skills (Doucette, 1994) will require students exhibit the ability to gain access to information, to interpret it, to apply it, and use it collaboratively to solve problems. These changes will require a more rapid, on-going program review and curriculum/program development process, especially in occupational training programs such as those offered by NMTC. Ehrmann (1995, p. 12) says: "Today's technologies are increasing the possibilities for augmenting the learning/teaching process with experiential learning, collaborative learning, and rich, frequent feedback." New technology-based programs and courses (Ehrmann, 1995) foster more student responsibility for learning while giving students material more worth learning. It would seem that the technology-based learning environment currently evolving would be effective in the NMTC learning environment.

For a technology-based learning environment to achieve its full potential to enhance the learning experience would require a faculty role change (from sage on stage to guide on the side). New faculty skills will include those of (a) instructional designer; (b) creator of learning environments, particularly interactive; (c) organizer, controller, evaluator of student-centered learning; (d) user of varied instructional delivery systems, subject matter expert (teaching and learning) for interactive educational software development; (e) developer of interactive learning, utilizing authoring systems; (f) user of computers and other technologies as instructional delivery tools; and (g) user of computers as administrative tools (Pina & Savenye, 1992). Faculty will primarily be designers and managers of a multisensory learning environment striving to optimize learning by matching the learning experience to a student's learning style and needs. This list of skills provides a solid planning foundation for future HRD efforts at NMTC.

The focus of control in this new learning environment (Doucette, 1994) will shift from teacher to student. Faculty will control content, design, standards and assessment while students will decide on the delivery mechanism and time best for their particular circumstances. While this scenario offers much potential for change, it may come slowly as faculty will have to develop new skills while maintaining their current teaching responsibilities. Therefore, the major focus of a multimedia integration plan at NMTC must be on faculty training and incentives, in the use of new hardware and software technologies, and development of new pedagogical skills required in a student-centered, technology-based, learning environment.

With the current classroom economic model rapidly becoming economically unsustainable, technology offers the potential for greater effectiveness and efficiency (Doucette, 1994). Ongoing budget problems at NMTC with increased user fees, reductions in support services, and personnel reductions offer proof of the growing unsustainability of this model at NMTC. Doucett (1994) and Groff (1986) feel that the problem can only be dealt with through a fundamental restructuring of the learning environment. Several others (Guskin, 1994; Phelps, 1994; & Sanchez, 1994) also feel the key may lie in the proper application of new information technologies to all aspects of the learning environment. Combining these two perspectives with the original Branson (1990) changing paradigm concept lead to the technology-based learning paradigm. This model combined with the resulting plan should provide valuable vision and direction for NMTC planners for some time to come.

Although many people tout the economic and efficiency benefits of multimedia in the learning environment, the initial benefits will come in the areas of content, pedagogy, and curriculum (Green & Gilbert, 1995). Even if benefits in cost effectiveness are not readily apparent in the learning environment, a return on investment in administrative areas might occur much more quickly. Green and Gilbert (1995) feel that the three primary reasons to invest in information technology are (a) competitive position; (b) teaching, learning, and curriculum enhancement; and (c) student preparation. These are the areas in which NMTC planners should expect to initially find improvements generated by investing in technology.

Distance Education

The costs of bricks, mortar and transportation are steadily increasing while the costs of telecommunications are decreasing and its capabilities are increasing. Given NMTC's large rural service area and its current Tech Prep initiative, some form of distance learning effort may be in order. Graves (1995, p. 7) says:

> We must learn how to create a distributed learning environment combining the best features of traditional instructional models, whether classroom-based or real-time video-based, with the new asynchronous opportunities for sharing and communicating enabled by educational networks and their connections to the Internet.

This, coupled with the many growing number of communications consortia available within Maine and via the Internet, provide an unparalleled opportunity for NMTC to address the issue of information availability and increased access to learning opportunities. In particular, local cable TV company infrastructure availability and the ECO 2000 project offer two real possibilities for developing a distance learning function at NMTC.

The rapid rate of technological change is fostering rapid change in the skills needed within current occupations while making others obsolete and creating whole new occupations not previously considered. Brown (1995, p. 2) says: "As technological advances continue - and even speed up - it is likely that more and more people with hard-earned skills of the moment will become marginally useful as new skills replace them." This places a growing demand on HRD programs that is fostered by the necessity for lifelong learning and continued employment while learning. NMTC should also experience a rapid growth in requests for training through its Business and Industry Training Division, much of which could be delivered via a mix of various distance technologies and on-site learning experiences.

It appears to be an opportune time to become involved in distance delivery of learning when one compares current on-campus delivery costs, student scheduling problems, and the growing number of distance learning providers, both public and private. This coupled with the growing number of communication and networking initiatives underway in Maine may represent an important opportunity that should not be overlooked by the planning activities at NMTC.

Considerations for Instructional, Organizational, and Human Resource Development

The changes that these implications foretell will require on-going environmental scanning and a detailed planning effort such as that currently conducted by NMTC. The major goals of any technology plan should include (a) increased access to learning opportunities and (b) increased student achievement and learning efficiency (Dively, in Roth et al., 1990). Even though the resulting plan is divided into the three aspects of the technology-based learning environment the implications are discussed here as they relate to the three aspects of this research particular question.

Instructional Development

Initially, the major aspects of instructional development included in a plan for integration of multimedia technologies into the learning environment must focus on the necessary hardware and software acquisition and its optimal use to enhance the learning experience encountered by NMTC students. The primary objective would be to provide faculty with up-to-date hardware and software and promote their routine use for all classroom needs, both instructional and administrative.

The next stage of development would involve the use of the latest presentation development software to enhance lectures and other classroom presentations. The ultimate development will be the implementation of learner controlled, interactive learning experiences in which faculty will control content, standards and assessment means while students decide how and when the learning will take place (Doucette, 1994). Deeply involved in this stage is the change in faculty role and pedagogical methods needed to fully implement this learning scenario. The important point is that the focus of this change effort is on learning, not teaching which may necessitate a review of institutional mission and vision statements. The goals and objectives listed under the learning management part of this plan seek to begin the movement toward realizing these outcomes.

Organizational Development

Organizationally, it will be important that NMTC continues to expand its technological foundation and promote its routine use in daily activities. With nearly 50% of the campus connected to a fiber optic network and plans for the rest to be connected in the near future, NMTC is making good progress toward achieving these goals. This will provide the necessary central communications and database needed. Added network capability and external dial-up capability will make the campus network accessible by the entire campus community from internal and external campus locations.

The fostering of connectivity and the routine sharing of information will be further enhanced by promoting increased and routine involvement in the local and statewide communications consortia currently being developed from several sources. This connectivity holds potential to aid future growth of the Northern and Eastern Maine Tech Prep Consortium.

For the technology-based learning environment to reach and maintain its full potential in the learning environment there must be an institutional commitment to maintaining up-to-date hardware and software. This will necessitate the establishment of a regular capital budget process that provides for an on-going expenditure and amortization program. This program should be based on a 3 - 5 year schedule. This process would be optimized by establishing a V.P. level position responsible for technology decisions and directions (Ferrante et al., 1988). It could be housed in the faculty resource center, previously mentioned, and provide leadership in developing the technology-based paradigm at NMTC.

The transition to the learning environment of the future will also require a review of institutional mission and vision statements. Many aspects of both are based on the current teacher and teaching centered paradigm, and do not provide the direction needed to accomplish this fundamental restructuring of the learning environment.

Human Resource Development

As technological change speeds up, the human factor will become an increasing concern for NMTC leadership. Dealing with change and developing the ability to be lifelong learners are suddenly skills that survival in one's occupation demands. Education is no different. To cope with the changes being thrust upon it, higher education must develop a more refined and ongoing human resource development function. Brown (in Morrison, 1995, p. 2) says, "As technological advances continue--and even speed up--it is likely that more and more people with hard-earned skills of the moment will become marginally useful as new skills replace them." For educators, staying informed about changes in multimedia is also a matter of personal and professional necessity (Hofstetter, 1995) because. . . " the ability to use it is emerging as a life skill, [and] you will continually need to develop your multimedia techniques to stay competitive in your profession and live fully in the information society" (p. 183). While this provides an opportunity for NMTC to develop new markets with business and industry it also means that greater attention must be paid to the ongoing development of new faculty skills with a larger amount of institutional resources dedicated to this effort.

Assisting the campus community to successfully deal with the necessary change process required for transition to the new learning infrastructure will be a major concern for NMTC leadership. "When the climate of learning for staff is open, flexible, affirming, challenging, the climate of learning for students is likely to be similar" (O'Banion, in Stern, 1989, p. 1). The core of the learning process is an eager and involved faculty working to grow personally and professionally.

NMTC's current professional development program should be used to provide leadership in the implementation of faculty training in the use of multimedia technology and new teaching methods. A successful program (Stern 1989) would include (a) mechanisms for mutual planning, (b) institutional and professional needs assessments, (c) self-assessment, (d) cooperation with other community colleges in the region, (e) a variety of activities and opportunities, (f) appropriate incentives, (g) evaluation of individual offerings and the total program, (h) staff development opportunities widely publicized and promoted through a variety of media, (i) a statement of goals, (j) widespread use of professional and personal development plans, (k) strong administrative support of staff development, (l) clearly stated program goals and objectives supporting institutional mission and goals, and (m) year-round activity with primarily voluntary participation. Successful programs stretch faculty to see beyond their own individual growth and to understand their impact on students and the institution. These elements should be used as a standard by which to measure the success of professional development efforts at NMTC.

Based on the CBAM questionnaire results, the initial HRD efforts should initially concentrate on building awareness and information availability with the faculty. Providing faculty with training in the use of technology to meet administrative needs would be an important area to concentrate initial HRD resources. Training faculty in the use of presentation software to enhance lectures and presentations would be the next logical stage in the integration of multimedia technology into the learning environment at NMTC. The ultimate training for faculty should result in the use of course authoring software to develop faculty managed, student controlled, interactive learning environments at NMTC. This will also necessitate ongoing, adequately funded HRD programs for success.

Conclusions

The completion of this project yielded several major conclusions having impact on the future of the educational experience at NTMC. They are listed numerically as they apply to this project's research questions.

Hardware and Software Availability

1. A variety of hardware technologies is currently available. They offer much potential to enhance the learning environment and are constantly being improved.

2. Many software options are available that have the potential to enhance the learning environment. Four basic software types necessary for multimedia systems include (a) operating system software, (b) system-interface software, (c) authoring software, and (d) interactive courseware.

3. NMTC does not currently have adequate hardware or software to implement multimedia into the learning environment.

The Future for Campus-Based and Distance Learning Systems

1. Major changes must occur in the current learning delivery system in order to make it more effective and efficient in meeting the needs of students in a technological society.

2. Technological obsolescence is a regular facet of a technology--based learning environment, and must be met with adequate funding and a regular budgetary plan for routine amortization and replacement.

3. There are a growing number of accounts of successful use of new technology in the learning environment at all levels.

4. New technologies applied to the current teacher-centered model of education will achieve only marginal gains in effectiveness and efficiency. Their use must be accompanied by fundamental change in the learning environment if their full potential is to be realized.

5. In a student-centered, technology-based learning environment the focus will be on learning, not teaching. Faculty will control content, standards, and assessment means and students will control how and when learning takes place. Institution mission and vision statements should reflect this change of focus.

6. Many societal factors are combining to make distance learning delivery systems more desirable and cost effective.

7. NMTC must develop a distance learning program if it is to remain competitive with other post-secondary training providers.

Planning Considerations for Instructional, Organizational, and Human Resource Development

Instructional Development

1. A plan of multimedia integration must support the development of technology-based learning by focusing on the knowledge-database, communications, and learning management capabilities of the institution.

2. Instructional development aspects of the plan must include greater use of technology in the learning environment, development of alternative teaching, student assessment, scheduling, and delivery methods to maximize the value of technology used.

3. Learning, not teaching, must become the guiding focus of all educational activities at NMTC.

4. New foundation skills are being demanded by business and industry and NMTC's curriculum must include them if its students are to be competitive in the global economy.

5. The major goals of this plan should be (a) increased access to learning and (b) increased learning efficiency.

Organizational Development

6. Organizational development activities should promote greater use of electronic communications in the daily routine and focus on continued expansion of information access and accessibility through internal and external communications expansion and upgrades.

7. The plan must have participation of all members of the organization in order to maximize the buy in necessary for successful attainment of the goals.

8. The development of a faculty resource center containing the latest equipment with regular professional help available is a must if

NMTC is to make the transition to the technology-based learning environment currently developing.

9. NMTC must rapidly develop access to information resources and information tools available if it is to remain competitive with other post-secondary training providers, public and private.

Human Resource Development

10. Faculty at NMTC are interested in multimedia, but need more information to begin to implement it in the learning environment.

11. Maintaining multimedia expertise will soon be a matter of personal and professional necessity.

12. NMTC faculty will need to develop new skills if they are to implement a technology-based learning environment.

10. NMTC's professional development program must provide leadership in managing the change process, constantly assess faculty and staff training needs, and provide ongoing support for learning new skills in support of the new learning environment.

11. Adequate funding of an on-going professional development function at NMTC is imperative if the desired transition is to be made.

Implications

This project provided a basic list of multimedia technologies currently available to assist NMTC faculty to enhance the learning experience and a blueprint for the transition to the learning environment of the future. This transition has begun at various institutions around the country and NMTC must participate to remain competitive.

NMTC's ability to remain competitive with other learning providers may well depend on how well it utilizes these new technologies. New technology offers an opportunity for NMTC to better serve its customers with increased effectiveness and efficiency through a restructured learning process. Many aspects of this process are untried or yet to be developed and will require innovative leadership and zeal to accomplish.

All of the findings point to major changes in the learning process if institutions are to remain effective in providing the necessary learning experience for students in a technological society. Many of these changes will be painful and not all members of the campus community will readily agree to them. A well researched and highly participatory planning process combined with appropriate HRD programs will be necessary to off set concerns about the innovations being considered.

While some faculty at NMTC have begun to experiment with alternative teaching methods and technologies, this project illustrates the need for greater institutional support for faculty innovators. These people are a important catalyst for change and their efforts should be supported with adequate funding and technical support.

Discussion of the planning process in this project illustrated that many of the planning assumptions and objectives in NMTC's current five year plan relative to technological change within the learning environment were on target. This planning framework identifies several activities that may be useful in achieving these objectives and several others not originally listed.

Validation of this proposed plan by the expert review panel indicates that it contains the appropriate activities to move NMTC toward a technology-based learning environment. A technology based paradigm holds much promise to enhance future learning processes at NMTC because (Waterhouse. 1991, p. 92) ". . . technology offers us a tremendous opportunity to extend our capabilities as individuals, to reach new plateaus of excellence, to turn our vast silos of knowledge into a reality of lifelong learning for everyone". It is evident that major changes in information and communications technologies are occurring. Given the fact that information and communications are the major functions of the education enterprise, it should be assumed that major changes will also occur within the learning environment at NMTC.

Recommendations

Six recommendations were made as a result of this project. First, a regular, ongoing environmental scanning effort should be implemented to better assist NMTC to deal with the trends and issues affecting it and its customers in a timely manner.

Second, the technology-based paradigm resulting from this project should be considered the vision of the desired learning environment at NMTC. Leadership should consider it a template for fundamentally restructuring the learning environment at NMTC.

Third, this plan be totally implemented to facilitate a balanced development of a technology-based learning environment at NMTC. Used as a planning template within academic departments, the plan should become the template for individual faculty action plans.

Fourth, this plan be used by the professional development committee to plan the effective use of scarce HRD resources. Success of activities should be measured against successful attainment of planning goals and objectives.

Five, The plan goals and objectives impact several major aspects of institutional activities should be incorporated into the NMTC's strategic plan. This would facilitate plan implementation.

Six, the suggested evaluation methods contained in the plan be used to provide the foundation for a summative evaluation of the success of this plan. Formative, progress evaluations should be conducted on an annual basis.

Implementation

The implementation of this plan will be facilitated by the strategic planning committee. The president and the management team of NMTC are in full support of adopting and implementing the plan as a template for the future at NMTC.

The steps leading to implementation will include the following:

1. Review by the strategic planning committee. Once presented the committee members will need time to review and consider the ramifications of the plan. Members may choose to expand or reduce the overall number of goals and objectives to be implemented. Following this activity the plan will be incorporated into the campus strategic plan.

2. Department chairs will review the planning goals with their respective departments allowing individual faculty to incorporate goals in their individual action plans that are in support of the overall institutional plan.

3. Once individual action plans are completed the management team and department chairs will consider the necessary budget allocations necessary for each objective.

4. Activities requiring faculty training will be referred to the professional development committee for consideration as it makes plans for allocation of funding support.

Dissemination

Copies of this plan and a project report were disseminated to members of the strategic planning committee. Following review, discussion, and adoption by the committee was provided to individual faculty members. Copies of the plan were also provided to the academic deans of the other six campuses of the MTCS for their review and use as a local planning framework. A copy was also provided to the Maine Technical College System office for possible inclusion in system level planning activities. Member institutions of the Northern and Eastern Maine Tech Prep Consortium also received copies of this plan to provide a view of future directions at NMTC.

Improvement of Practice

It is anticipated that full implementation of this plan will provide a catalyst for fundamental restructuring of the learning environment. The resulting technology-based learning environment will allow students greater responsibility for their learning process and faculty greater flexibility in choice of teaching technique. It will provide greater flexibility in the delivery of services and assist NMTC to be more cost effective and competitive in an era of dwindling resources and changing student demands.

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APPENDIXES

Appendix A

Maine Technical College System Mission

The Maine Legislature established the Maine Technical College System with the charge of creating an educated, skilled, and adaptable labor force which is responsive to the workforce needs of the state's employers. Implicit in its mission, the Maine Technical College System is Maine's primary provider of technical education leading to the certificate, diploma, and associate degree.

Appendix B

Northern Maine Technical College Mission Statement

Northern Maine Technical College provides post-secondary technical and vocational programs which lead to associate degrees, diplomas, or certificates. These one and two-year programs of classroom and laboratory instruction provide individuals with the educational, occupational and technical knowledge required for employment in business, industry and government within the state. The primary goals of the institution are to create an educated, skilled and adaptable workforce which can respond to the changing needs of the economy of the Northern Maine region and the State and to promote local, regional and statewide economic development. Included in fulfilling these goals are programs, courses or seminars to increase the competence of employed adults, to provide specialized technical training to attract business and industry to locate in Northern Maine, and to encourage business and industry now located in the region to expand.

The following objectives guide the college in fulfilling its mission.

1. To prepare students for entry level positions in business, industry and public service
2. To offer technically current and continually improving curricula and services
3. To provide curricula that prepare individuals to be responsible and active citizens
4. To broadening the students' educational foundation to enable and encourage them to pursue lifelong learning
5. To utilize instructional processes that allow students to achieve at their maximum potential
6. To utilize knowledgeable public representatives to advise the institution regarding curricula needs and program content
7. To provide enhanced guidance and placement services to assist prospective students, enrolled students, and graduates
8. To provide enhanced developmental educational opportunities for individuals who need to strengthen academic skills to pursue their education
9. To provide enhanced opportunities for students to participate in cultural, athletic, community service, and social extracurricular activities

Appendix C

Maine Technical College System Vision Statement

The Maine Technical College System is committed to a vision which assures that its graduates possess the occupational and academic skills required by employers in a global marketplace, including essential problem-solving, analytical, communication, and interpersonal skills.

Appendix D

Northern Maine Technical College Vision Statement

Northern Maine Technical College, in fulfilling its mission, will provide quality state-of-the-art occupational programs which will be continually reviewed and adjusted as necessary to integrate recent innovations, techniques, procedures, and revised needs of employers of graduates and students.

In this process, the college will work to influence the holistic development of all students to enhance their contribution to society. For employees of NMTC to achieve our vision, the elements below are essential to provide quality service and to demonstrate excellence to those we serve.

Effectiveness

To continue providing quality programs and services, each employee must commit to understanding the need for and to assist in developing effective teamwork a) within each department, b) between departments, and c) between divisions with each area voluntarily supporting other areas in fulfilling the fundamental mission of service to our students.

Each employee should understand that our role in providing occupational education is in a rapid change process and that this change process is expected to continue for the foreseeable future. This must be viewed as an opportunity to grow, learn new technology and assist in serving as a leading change agent to improve the standard of living for those individuals and constituents which NMTC serves and for the community in which we live.

Quality and Excellence

At the core of an organization are its employees. Consequently, each employee of the college is the individual who must be responsible for quality service and who must demonstrate excellence to students, employees, community leaders, and fellow employees. The rapid development of information and technology requires each of us to grow in the knowledge and understanding of our job function. Our motto

"TOWARD EXCELLENCE", communicates two important characteristics of a dynamic college:

1. Each employee desires to provide quality service at a high degree of excellence. As an institution education and training individuals, each employee serves as an ambassador to all individuals who come to NMTC to learn or to visit. As ambassadors our actions are observed by all. Then, to be excellent, all of our activities must be exemplary, promoting an environment of truth, trust, respect, professionalism, and caring in all activities.

2. Each employee is dedicated to improving and to providing excellent service. With each employee striving to implement improvements, the college will respond positively to expectations set forth by such external influences as the board of trustees, accrediting bodies, technological developments, employers' needs, etc.

Responding to Community Needs

The specific goals and objectives of the college will be refined and updated annually to reflect the MTCS goals and objectives; to respond to student and employer needs; to renew the commitment to the college's mission; and to enhance the college's overall effectiveness to the community and the state.

All employees are expected to continually foster the commitment to serve a diverse population of students, recognizing each individual as a person and helping that person develop an understanding of the necessity to weave into the fabric of our society.

Recognizing that the state's budget must serve diverse needs with limited revenue, all employees and especially faculty and administrators are expected to work to increase revenue diversity by seeking ways to enhance alternative revenue sources: i.e. grants and foundation giving and conservation available resources.

Image Enhancement

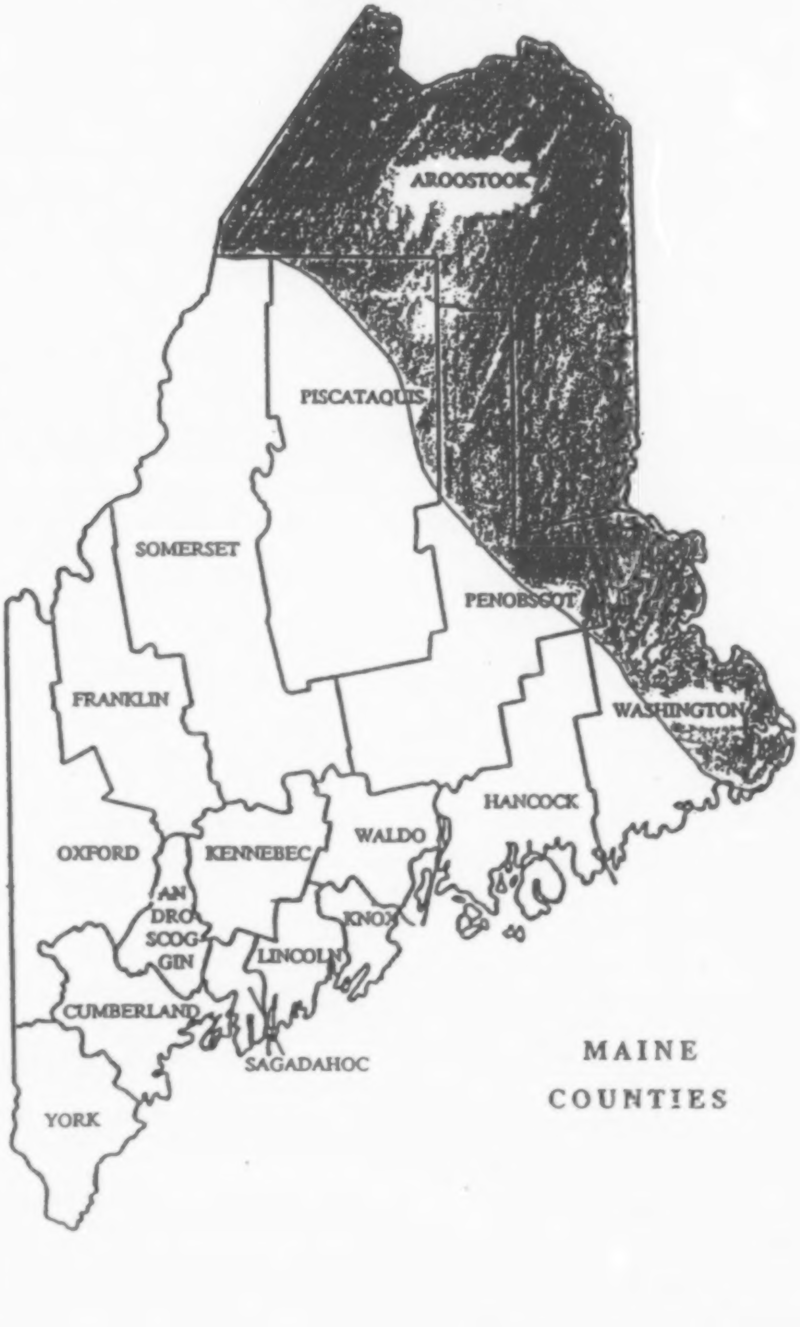
By building upon the college's reputation for providing graduates with quality occupational skills, the college will enhance the growing perception among the publics we serve the NMTC is the college to attend for technical education for the future with the excellent options of a) employment after one or two years and b) upward educational mobility for graduates. The colleges's image is expected to convey that opportunities are available to help area residents make the transition to the workforce of the future, which requires lifelong learning and a continual updating of one's occupational skill to assure access to and security in future jobs.

Strategic Planning

The fulfillment of this vision will be achieved through the goals, objectives and action plans contained in the college's strategic plan which will be reviewed and updated annually.

Appendix E

Northern and Eastern Maine Tech Prep Consortium Service Area Map


AROOSTOOK
PISCATAQUIS
SOMERSET
PENOBSCOT
FRANKLIN
WASHINGTON
HANCOCK
WALDO
OXFORD
KENNEBEC
AN DRO SCOG GIN
KNOX
LINCOLN
CUMBERLAND
SAGADAHOC
YORK
MAINE
COUNTIES

Appendix F

Northern and Eastern Maine Tech Prep Consortium Member Organizations

Secondary Schools

Ashland Community H.S.

Calais H.S.

Caribou H.S.

Caribou Reg. Tech. Ctr.

Central Aroostook H.S.

East Grand H.S.

Van Buren H.S./R.V.C.

Fort Fairfield H.S.

Presque Isle H.S.

Woodland H.S.

Katahdin H.S.

Lee Academy

Limestone H. S.

Lubec H.S.

Madawaska H.S.

Stearns H.S.

Easton H.S.

Washburn H.S.

Wisdom H.S.

Houlton H.S.

Schenk H.S.

Shead H.S.

S.Aroostook Comm. H.S.

St.Croix Reg. Tech. Ctr.

St.John Valley Tech. Center

Mattanawcook Academy

Penobscot Valley H.S.

Fort Kent Com. H.S.

Hodgdon H.S.

Presque Isle Regional Tech. Ctr.

N. Penobscot Tech. Region III

Post Secondary Schools

Northern Maine Technical College

Washington County Technical College

Appendix G

Information Sources from Hofstetter (1995)

1. NewMedia - P.O. Box 1771, Riverton, NJ 08077-7331. Phone (415) 573-5170. Fax (415) 573-5131. Free to qualified readers.

2. Morph's Outpost - P.O. Box 578, Orinda, CA 94563. Phone (510) 238-4545. Fax (510) 238-9459.

3. Multimedia Today - IBM Multimedia Solutions, 411 Northside Parkway, Atlanta, GA 30327. Fax (404)238-4298. Free to qualified readers.

4. Internet World - Mecklermedia Corporation, 11 Ferry Lane West, Westport, CT 06880. Phone (203) 226-6967. Fax (203) 454-5840. E-mail meckler@jvnc.net.

5. T.H.E. Journal - 150 El Camino Real, Suite 112, Tustin, CA 92680. Phone (714) 730-4011. Fax (714) 730-3739. Free to qualified individuals in educational institutions and training departments in the U.S. and Canada.

6. Technology & Learning - Peter Li, Inc. 330 Progress Road, Dayton, OH 45449. Phone (513) 847-5900.

7. The Videodisc Compendium - Emerging Technology Consultants, 2819 Hamline Avenue North, St. Paul, MN 55113. Phone (612) 639-3973. Fax (612) 639-0110.

8. CD-ROM World - Mecklermedia corporation, 11 Ferry Lane West, Westport, CT 06880. Phone (203) 226-6967. Fax (203) 454-5840. E-mail meckler@jvnc.net.

9. Virtual Reality World - address same as number eight above.

10. Higher Education Product Companion - HEPC Subscription Services, 1307 S. Mary Avenue, Suite 218, Sunnyvale, CA 94087. Phone (408) 773-0670. Free subscriptions to those that qualify.

11. Communications Industries Report - ICIA, 3150 Spring Street, Fairfax, VA 22031-2399. Phone (703) 273-7200. Fax (703) 278-8082.

12. Cinefex - P.O. Box 20027, Riverside, CA 92516. Phone (909) 781-1917.

The following four multimedia CD's are also listed:

1. Nautilus - a multimedia magazine published on CD-ROM. To get free trial issue, phone (800) 448-2323.

2. Medio Magazine - Medio Multimedia Inc., P.O. Box 10844, Salinas, CA 93912. Phone (415) 626-2147.

3. Substance.digizine - Substance Interactive Media Inc., 444 Grove Street, San Francisco, CA 94102. Phone (415) 626-2147.

4. CD-ROMs in Print - See previous Mecklermedia listing in number eight above.

Catalogue resources listed by Hofstetter (1995) include:

1. Directory of Multimedia Equipment, Software & Services. International communications Industries Association, 3150 Spring Street, Fairfax, VA 22031-2399. Phone (703) 273-7200. Fax (703) 278-8082.

2. NewMedia Source Book - Hypermedia communications, Inc., 901 Mariner's Island Boulevard, Suite 365, San Mateo, CA 94404. Phone (415) 573-5170. Fax (415) 573-5131.

3. CD-ROM's in Print- Mecklermedia Corporation, 11 Ferry Lane West, Westport, CT 06880. Phone (203) 226-6967. Fax (203) 454-5840. E-mail, meckler@jvnc.net.

Professional Associations identified by Hofstetter include:

1. Association for Educational Communications and Technology (AECT) - Publishes monthly magazine Tech Trends. AECT, 1025 Vermont Avenue NW, Suite 820, Washington, DC. Phone (202) 347-7834. Fax (202) 347-7839.

2. Society for Applied Learning Technology (SALT)- 50 Culpeper Street, Warington, VA 22186. Phone (703) 347-0055.

3. International Communications Industries Association (ICIA) - 3150 Spring Street, Fairfax, VA 22031-2399. Phone (703) 273-7200. Many other professional associations not listed here are also excellent sources for information concerning up-to-date information concerning multimedia utilization in the learning environment.

Conferences and Exhibits are another excellent source of multimedia information. Those listed in Hofstetter (1995) include:

1. INFOCOMM - annual exhibit of audiovisual and new media equipment. Contact ICIA, 3150 Spring Street, Fairfax, VA 22031-2399. Phone (703) 272-7200. Fax (703) 278-8082.

2. COMDEX - twice a year huge exhibition of computer technology. Interface Group, 300 First Avenue, Needham, MA 02194-2722. Phone (617) 449-6600. Fax (617) 449-2674.

3. CeBit - world's largest computer show, every spring in Hanover, Germany. Phone (609) 987-1202.

4. InterMedia - international conference on CD-ROM and multimedia. NewMedia, P.O. Box 1771, Riverton, NJ 08077-7331. Phone (800) 832-3513.

5. NewMedia Expo - Interface Group, 300 First Avenue, Needham, MA 02194-2722.

6. Virtual Reality Expo - Mecklermedia Corporation, 11 Ferry Lane West, Westport, CT 06880. Tel. (203) 226-6967,e-mail meckler@jvnc.net.

7. Ed-Media - international conference on educational multimedia and hypermedia. Association for the Advancement of Computing in Education (AACE), P.O. Box 2966, Charlottesville, VA 22902. Phone (804) 973-3987. Fax (804) 978-7449. E-mail AACE@virginia.edu.

8. NAB Multimedia World - annual conference sponsored by the Interactive Multimedia Association. Phone (202) 775-4972. Fax (301) 216-1847.

9. National Net - annual conference dealing with the issues involved with creating the Information Superhighway. Details are available by Gopher at educom.edu. Phone (202) 872-4200.

10. Interactive Healthcare - annual conference dealing with technology applications for medicine, nursing, allied health, continuing education, and patient education. Phone Stewart Publishing at (703) 354-8155. Fax (703) 354-2177.

If travel budgets are minimal or nonexistent, Hofstetter lists the following networked resources:

1. EDUPAGE - triweekly digest of the week's major news items on information technology. It is available by Gopher from educom.edu. Subscriptions are available by e-mail to listproc@ivory.educom.edu. The message should read subscribe EDUPAGE first name last name.

2. Electronic Frontier Foundation - concerned with the legal, social, and political aspects of networks. Send e-mail message to eff-request@eff.org. Message - "please add me to your mailing list."

3. Internet Resources Listserve - e-mail this message to listserve@vm1.nodak.edu. "Subscribe news your_name."

4. FTP Sites - At dartcms1.dartmouth.edu, in the directory *siglists*, the filename READ.ME contains several thousand listings.

5. HOTT - stands for Hot Off The Tree. This is a free monthly newsletter featuring the latest information on the latest advances in information technology. Send subscription requests to listserv@ucsd.edu. Leave the subject line blank. In the body of the message enter SUBSCRIBE HOTT-LIST.

Appendix H

Letters of Support

NMTC
Office of the President

Northern Maine Technical College
33 Edgemont Drive
Presque Isle, Maine 04769
207.768.2806
FAX 207.768.2813

August 16, 1994

Mr. Terry Overlock
P.O. Box 89
Portage Lake, ME 04768

Dear Terry:

A review of your proposal "A Multi-Year Action Plan for the Utilization for the Utilization of Multimedia Technology at Northern Maine Technical College" reveals that this project could be most useful to NMTC as a plan is developed for the inclusion of multimedia instruction in the various instructional areas. I expect that the Strategic Planning Committee will be actively involved in developing an implementation plan for the use of multimedia instruction.

I am sure that your work will serve as a most important resource for this important activity. If I may be of assistance as you progress through your project, please do not hesitate to contact me.

Sincerely yours,

Durward

Durward R. Huffman
President

DRH:dlp

pc T. Crowley

NMTC

Office of the Vice President
and
Dean of the College

Northern Maine Technical College

33 Edgemont Drive
Presque Isle, Maine 04769
(207) 768-2811
FAX (207) 768-2813

August 16, 1994

Terry Overlock
P.O. Box 89
Portage Lake, Maine 04768

Dear Terry:

I have read your Applied Research Project titled A Multi-Year Action Plan for the Utilization of Multimedia Technology at Northern Maine Technical College.

This project would prove beneficial to the college as we prepare for our next Title III submission.

If I can be of any assistance to you with this effort, please do not hesitate to contact me. Best of luck!

Sincerely,

Timothy D. Crowley,
Vice President

TDC:jmc

Appendix I

NMTC Multimedia Equipment and Software Use Inventory

NMTC Multimedia Inventory Date______________

Department______________________________

Location		Equipment Type							
Room	Office	Computer	VCR	TV	Videodisc	Scanner	CD-ROM	Printer	Other

FACULTY SOFTWARE USE SURVEY

This survey seeks to identify software commonly used by faculty at NMTC including software packages regularly used to support administrative functions and those used in the classroom learning environment. Please complete and return to Terry Overlock by Friday November 3. Thank you for your response.

Name________________ Noncomputer users check here_____

Operating System Regularly Used

DOS____ WINDOWS____ WINDOWS '95____ OS2____ OTHER___
(check more than one if necessary)

Administrative Uses
(check all that apply)

Gradebook___ Database ___ Test Preparation__ Desktop Publishing___

Presentation Development___ Wordprocessing___ Internet___ Other___

System maintenance (virus protection, etc)___ Authoring Software____

Classroom Uses
(check all that apply)

Remedial Practice___ Tutorials___ Integral Part of Course___

Interactive Multimedia___ Internet___ Wordprocessing___ Database__

Desktop Publishing___ Presentation Development___ Other____

Please list software packages you would use if you had access to them.

____

____

____

On the lines below please list the software programs you use regularly.

____

____

Appendix J

Concerns Based Adoption Model Questionnaire

Concerns Questionnaire

In order to identify these data, please give us your Social Security Number.

___ ___ ___ ___ ___ ___ ___ ___ ___

The purpose of this questionnaire is to determine what people who are using or thinking of using various programs are concerned about at various times during the innovation adoption process. The items were developed from typical responses of school and college teachers who ranged from no knowledge at all about various programs to many years experience in using them. Therefore, a *good part of the items on this questionnaire may appear to be of little relevance or irrelevant to you at this time.* For the completely irrelevant items, please circle "0" on the scale. Other items will represent those concerns you do have, in varying degrees of intensity, and should be marked higher on the scale. For example:

This statement is very true of me at this time	0 1 2 3 4 5 6 7
This statement is somewhat true of me now	0 1 2 3 4 5 6 7
This statement is not at all true of me at this time	0 1 2 3 4 5 6 7
This statement seems irrelevant to me	0 1 2 3 4 5 6 7

Please respond to the items in terms of *your present concerns*, of how you feel about your involvement **multimedia in the learning environment.** We do not hold to any one definition of this program, so please think of it in terms of *your own perceptions* of what it involves. Remember to respond to each item in terms of *your present concerns* about your involvement or potential involvement with the above named innovation.

Thank you for taking time to complete this task

SCALE

0	1	2	3	4	5	6	7
irrelevant		not true of me now		somewhat true of me now		very true	

1. I am concerned about students attitudes toward this innovation. 0 1 2 3 4 5 6 7

2. I now know of some other approaches that might work better. 0 1 2 3 4 5 6 7

3. I don't even know what the innovation is 0 1 2 3 4 5 6 7

4. I am concerned about not having enough time to organize myself each day 0 1 2 3 4 5 6 7

5. I would like to help other faculty in their use of the innovation. 0 1 2 3 4 5 6 7

6. I have very limited knowledge about the innovation 0 1 2 3 4 5 6 7

7. I would like to know the effect of reorganization on my professional status. 0 1 2 3 4 5 6 7

8. I am concerned about conflict between my interests and my responsibilities. 0 1 2 3 4 5 6 7

9. I am concerned about revising my use of the innovation. 0 1 2 3 4 5 6 7

10. I would like to develop working relationships with both our faculty and outside faculty using this innovation. 0 1 2 3 4 5 6 7

11. I am concerned about how the innovation affects students. 0 1 2 3 4 5 6 7

12. I an not concerned about this innovation. 0 1 2 3 4 5 6 7

13. I would like to know who will make the decisions 0 1 2 3 4 5 6 7

14. I would like to discuss the possibility of using the innovation. 0 1 2 3 4 5 6 7

15. I would like to know what resources are available if we decide to adopt this innovation. 0 1 2 3 4 5 6 7

16. I am concerned about my inability to manage all the innovation requires. 0 1 2 3 4 5 6 7

17. I would like to know how my teaching or administration is supposed to change. 0 1 2 3 4 5 6 7

18. I would like to familiarize other departments or persons with the progress of this new approach. 0 1 2 3 4 5 6 7

19. I am concerned about evaluation my impact on students. 0 1 2 3 4 5 6 7

20. I would like to revise the innovation's instructional approach. 0 1 2 3 4 5 6 7

21. I am completely occupied with other things. 0 1 2 3 4 5 6 7

22. I would like to modify our use of the innovation based on the experiences of our students. 0 1 2 3 4 5 6 7

23. Although I don't know about this innovation, I am concerned about things in this area. 0 1 2 3 4 5 6 7

24. I would like to excite my students about their part in this approach. 0 1 2 3 4 5 6 7

25. I am concerned about time spent working with nonacademic problems related to this innovation. 0 1 2 3 4 5 6 7

26. I would like to know what the use of the innovation will require. 0 1 2 3 4 5 6 7

27. I would like to coordinate my effort with others to maximize the innovations's affects. 0 1 2 3 4 5 6 7

28. I would like to have more information on time and energy commitments required by this innovation. 0 1 2 3 4 5 6 7

29. I would like to know what other faculty are doing in this area. 0 1 2 3 4 5 6 7

30. At this time, I am not interested in learning about this innovation. 0 1 2 3 4 5 6 7

31. I would like to determine how to supplement, enhance, or replace the innovation. 0 1 2 3 4 5 6 7

32. I would like to use feedback from students to change the program. 0 1 2 3 4 5 6 7

33. I would like to know how my role will change when I am using the innovation. 0 1 2 3 4 5 6 7

34. Coordination of tasks and people is taking too much of my time. 0 1 2 3 4 5 6 7

35. I would like to know how this innovation is better than what we have now. 0 1 2 3 4 5 6 7

Taken from:

Hord, S., Hall, G., Rutherford, W., & Huling-Austin, L. (1987). Taking charge of change. Alexandria, VA. Association for Supervision and Curriculum. Austin, TX. Southwest Educational Development Lab.

Appendix K

Letter to Local Cable Companies

June 15, 1995

Mr. Barry McCrum
Manager, Paragon Cable Company
Caribou, ME 04736

Dear Sir:

I am currently working to develop a multiyear plan for the integration of multimedia technology into the learning environment at NMTC. A major aspect of any technology plan must focus on developing the capability to deliver the learning experience through distance delivery methods.

I am writing to determine what capability Paragon has to assist with distance delivery of training services within our service area. It is also important to determine your firm's interest in working with NMTC to deliver these services is also an important part of any such plan.

Any information you might share with me regarding Paragon's ability and interest to deliver distance learning would be greatly appreciated. Thank you for you time and assistance.

Sincerely,

Terrence H. Overlock, Sr.

Appendix L

Tech Prep Consortium Technology Survey and Cover Letter

Dear ---------

We share the goal of improving the quality of life for all people through high quality education programs and services. Learning for all people can be enhanced through technology. In fact, without access and use of technology, students are receiving less than a high quality education. Regular on-line connection to Nova Southeastern University in Fort Lauderdale through the local Tymnet satellite service has made it possible for me to pursue a doctorate and still maintain my position at NMTC. This just one example of the potential that modern communications technology holds for professional development and high quality education at all levels.

States and regions are making extensive use of technology. North Carolina is implementing asynchronous transfer mode (ATM) technology in 58 high schools, 18 community colleges, and 16 campuses of the University of North Carolina System. And, as you know, Maine is presently developing a statewide technology plan. Within our own region, two communication consortia have been formed, ECO 2000 and Atlas Five, and have promised to radically alter the way we do our business in the future.

All of these advances are capital intensive, usually requiring a resource infusion above and beyond the usual operating budget. One such source of outside capital, the U.S. Department of Commerce, is attempting to accelerate work on the National Information Infrastructure through the National Telecommunications and Information Administration (NTIA). Last year $14,400,000 was awarded to 92 projects. This year $64,000,000 will be awarded for projects. I have included a copy of the program description.

Even though it is too late for this year, it is not too late to begin planning for next year. I have also included the abstract of a U.S. Dept. of Education report "Using Technology to Support Educational Reform." It also may be of use in the planning process.

NMTC is currently developing a multiyear plan for the integration of multimedia technology into the learning environment. Although the project is focused primarily on NMTC's internal environment, we want to coordinate our planning with that of the schools. We are interested in the technology you have now and how it is being used and the technology you are planning to acquire over the next several years.

The enclosed survey will be conducted by phone within two weeks of your receiving it and has been provided to assist you in preparing for the interview. If you are aware of other pertinent information that should be included please make a note to include it in the phone interview.

With the right planning, students at all levels will receive the best possible education supported by the latest in technology. Imagine the potential for collaboration within our consortia, within Maine, and with other states.

Your assistance with this project is greatly appreciated and will do much to assist NMTC to stay abreast of technological change within the consortium.
Thank you for your time and assistance. I look forward to our discussion.

Sincerely,

Terrence H. Overlock, Sr.

TECHNOLOGY SURVEY **DATE**______________

School____________________ Contact Person__________________

TECHNOLOGY AVAILABLE AT YOUR SCHOOL

COMPUTERS Type/Availability

IBM/Clone_____ Apple______ Other____
number number number

VCR'S_____CD-ROM_____T.V._____ Videodisc_____ Printers____
number number number number number

scanners______Overhead Projectors._____ Other_____
number number number

Internet connection available? YES____NO____ If yes is it used for:

class work? YES____NO____

faculty research? YES____NO____

other? YES____NO____

Other outside connections?

America On Line__Compuserve__Prodigy___Other____

Are school computers networked? YES____NO____

How many networks? __________

Are computer labs available YES____NO____ If yes: How many?___

How many computers per lab?_____

Dedicated to one program?___ Multiple Programs?___

Does each faculty member have access to a computer dedicated to their use? YES_____NO____

TECHNOLOGY USE PROFILE

CLASSROOM COMPUTER USAGE

PLEASE ESTIMATE %OF TOTAL TIME

Administrative (grades, attendance, etc.) ______

CAI ______

CAD ______

Drill and Practice ______

General office training (word processing, spreadsheets, etc.) ______

Multimedia Presentations ______

Other ______

Multimedia Definition: the use of a computer to present and combine text, graphics, audio, and video links and tools that let the user navigate, interact, create, and communicate.

ARE MULTIMEDIA APPLICATIONS

A. Used in the classroom? YES_____ NO_____

B. Used as supplements to usual presentations? YES _____ NO_____

C. Used as the primary delivery device? YES_____ NO_____

PLEASE LIST MOST POPULAR SOFTWARE PACKAGES USED.(ie. Lotus, Wordperfect, Word, etc.)

ARE MULTIMEDIA APPLICATION PROGRAMS

A. Purchased ready to use? YES____ NO____

B. Produced on-site by faculty YES____ NO____

If so, please list software used to produce presentations.

LIST ANY COURSES TAUGHT VIA COMPUTER-MULTIMEDIA

LIST WHAT YOU FEEL ARE BARRIERS TO TECHNOLOGY INTEGRATION INTO THE LEARNING ENVIRONMENT.

DOES YOUR SCHOOL HAVE A TECHNOLOGY PLAN/VISION FOR TECHNOLOGY IN THE LEARNING ENVIRONMENT? yes___no___
(If yes, please include a copy with the returned survey)

CURRENT AND PROJECTED MULTIMEDIA EQUIPMENT EXPENDITURES?

Appendix M

Letter to Successful Multimedia Program Leaders

June 18, 1995

Dear _________

I am working to develop a multiyear plan for the integration of multimedia into the learning environment at NMTC. Your efforts to accomplish this within your institution have become known to other institutions working to accomplish the same kind change in the learning environment.

Your assistance in providing information about your successful efforts would be very helpful in this plan development process. In particular, I am interested in the following:

1. How did you initiate the development process at your institution?
2. What was the vision that started this process?
3. What was the initial plan and how was it funded?
4. What progress has been made to fully implement multimedia?
5. How did your institution implement this change process?
6. Please list any important points we should keep in mind in our development process.
7. What were or continue to be the major barriers to this change process encountered at your institution?
8. What progress has been made within your institution to implement multimedia techniques into the learning environment?

Thank you for your input and assistance in this project. I look forward to further discussions with you concerning multimedia use in the learning environment.

Sincerely,

Terrence H. Overlock, Sr.

Appendix N

Trends and Related Issues

Table 3.

Demographic Trends and Related Issues

Trends	Related Issues
18% population decline in Aroostook County 1980 to 1990. Current population of 86,936 expected to decline to 72,000 by the year 2000. Continued population growth in southern Maine.	1. How will this affect the current 80% Aroostook portion of the student body - increase in recruitment area? 2. Increased Canadian recruitment?
1980 - 1990 0 - 17 age group declined 23 %. 18 - 24 age group declined 28%. 25 - 44 age group increased 16%, 32 % in state overall. 65 and older age group increased 17 %.	1. Dwindling numbers of high school graduates in the potential applicant pool. 2. Average age of students in NMTC classrooms will increase. 3. Broader age range within the student body. 4. Increased need for attention to adult learning styles - needs.
Female householders with no husband present increased 9.36%. 72% of female householders with children under five live below the poverty level.	1. Increased need for financial aid, on-site child care and other support services. 2. Reduction in future applicant pool - poverty reduces educational aspirations. 3. Need for different schedules and means for delivering services.

Table 4.
Economic Trends and Related Issues.

Trends	Issues
Unemployment currently averaging 10%. Aroostook's unemployment rate 44% greater than Maine's.	1. Greater numbers of people applying for retraining. 2. Greater need for variation in class schedule and delivery means. 3. More attention to business and industry training efforts.
Service occupations grew by 31% or 1,129 jobs. Sales occupations up 27%. Technicians and related support up 18%. Executive, administrative, and managerial up 16%. Natural resource occupations down 591 jobs or 24%.	1. Ongoing external environmental review to maintain program relevance and new program development.
New Activities	
Job Corps Center at former Loring AFB with 125 - 150 new jobs and $5 million payroll.	1. Potential client for NMTC programs.
Defense Finance and Accounting Service Center at former Loring AFB with 750 jobs and $22.5 million payroll. Aroostook Center Mall with 700 new jobs and $7.8 million payroll.	1. Potential employer of business graduates. 2. Potential customer for retraining and skill upgrading.

(table continues)

Trends	Issues
Resource changes -	
Since 1989, 1992 only year that state funding exceeded the inflation rate. Future budgetary support in limbo. Since 1989 student costs on the increase - dorm rental up 57%, tuition up 75%. Student financial aid resources remain limited to end of decade.	1. Explore alternative funding sources. 2. Explore new organizational structures and methods for delivering training services. 3. Current economic model for education may have reached the limit of its efficiency. 4. Ability of students to afford services may have reached the limit.

Table 5.

Educational Trends - Competitors

Trends	Issues
Increased calls for a new metric other than the Carnegie unit - ie. Outcomes assessment	1. Curriculum revision 2. Faculty training
Increased calls for a restructured learning environment	
Changing faculty role - move from sage on stage to guide on the side.	1. Faculty training 2. Resistance to change

(table continues)

Trends	Issues
Increased ties to business and industry.	1. Increased financial support of programs. 2. Use of business and industry prepared curriculum
Increased use of technology	1. Equipment maintenance. 2. Restructured learning environment. 3. Staff training. 4. Keeping equipment up-to-date.
Information availability and accessibility a more important competitive reference point than bricks and mortar.	1. Ongoing capital expenditures with regular amortization plan. 2. Maintaining trained staff. 3. Future accreditation standards. 4. Competitive edge with other providers.
Increased use of integrated learning systems	1. Curriculum revision. 2. Restructured learning environment. 3. Staff development. 4. Increasing efficiency and effectiveness of programs.
States adopting electronic media as approved texts.	1. Texts on electronic media in the near future? 2. Production of inhouse "books" via CD-ROM.
Institutional effectiveness and accountability	1. Measuring student outcomes and skill attainment. 2. Demonstrating effectiveness and efficiency to legislative bodies.

(table continues)

Trends	Issues
Increased private competition - military, business and industry, and private proprietary institutions.	1. Collaboration with private industry. 2. Utilize their prepared programs for training.
Current economic model becoming more and more unsustainable under current societal conditions.	1. Organizational restructuring. 2. More efficient and effective processes. 3. New ways of assessing faculty performance. 4. New ways of determining faculty work load.
Increased calls for restructuring learning environment and delivery system - technology-based and student centered.	1. Developing the vision and will to begin the change process. 2. Faculty training and practice with new teaching techniques. 3. Identify, purchase, and maintain the appropriate equipment. 4. Revise and restructure the learning environment. 5. Varied scheduling to meet diverse student needs.
Increasing evidence of efficiency and effectiveness of multimedia in the learning environment and rising tide of favorable expert opinion.	1. Making the necessary change in order to be competitive. 2. Staff training. 3. Making staff aware of successes elsewhere.

(table continues)

Trends	Issues
Increasing delivery of services via distance various media.	1. Not offering distance or distributed learning may limit student enrollment 2. Deciding what media to use 3. Revising curriculum 4. Training faculty
Increasing momentum of the quality movement within higher education.	1. Commitment to Continuous Quality Improvement 2. Continuous staff training
Increased use of multimedia and other educational technology at the K- 12 level.	1. Raised expectations of incoming students 2. Not integrating multimedia into the learning environment may limit student enrollment
Services delivered anywhere, anytime, anyplace	1. Providing organizational means to meet future customer demands 2. Establishing distance education delivery system

Table 6.

Legal - Political Trends

Trends	Issues
Changing political environment.	1. Maintaining close contact with legislative representatives 2. Developing greater flexibility in planning and operations 3. Increase alternative funding

(table continues)

Trends	Issues
Increased calls for institutional accountability and effectiveness evidence	1. Documentation of student skill attainment. 2. Documentation of cost effectiveness and efficiency.
Decreased federal government role.	1. Increased competition for block grant funds. 2. Lack of national direction for education. 3. Greater need to cultivate business and industry collaboration.

Table 7.

Competitors - Public and Private

Trends	Issues
Increased technology integration planning activity - K - 12, postsecondary.	1. Incoming students will have greater expectations for the learning experience and NMTC. 2. Opportunity for collaboration 3. Opportunity to provide leadership in the restructuring of the learning environment.
Private industry developing and marketing integrated multimedia training programs - John Deere, Caterpillar, Associated General Contractors, and others.	1. Private vendors competing with NMTC programs. 2. Opportunity for positive partnership through use of prepared curriculum.

(table continues)

Trends	Issues
Increased business - higher education collaboration for skills updating.	1. Increasing responsibility- may become more important than basic degree training. 2. Designing programs and reacting to business requests for training in a timely manner. 3. Who has controls the program?
Proper use of timely information for planning has increased importance for institutional effectiveness and survival.	1. Increased need for external audit and data analysis. 2. A greater factor in institutional survival.

Table 8.

Technological and Occupational Trends and Issues

Trends	Issues
95 % growth in the Internet last year 159 nations connected currently 3.2 million U.S. computers connected	1. Increased use in operations. 2. Availability will be an important competitive selling point. 3. Availability of courses from locations other than NMTC.
Technology changing the nature of what needs to be learned, who will learn it, who will provide it, and how it will be paid for.	1. Including new skills training in learning environment. 2. Taught separately and measured or integrated part of learning experience?

(table continues)

Trends	Issues
Occupational skills have short life span - less than five years.	1. New program development 2. Ongoing program revision 3. Stronger retraining and skills up-dating effort.
Information proliferation making it impossible for technicians to know all necessary information.	1. New skill development - accessing information, applying it, using to solve problems, and for collaborative teamwork.
Rapidly changing work environment, old occupations disappearing and new ones emerging.	1. Increasing operating flexibility for quicker program change. 2. Retraining staff. 3. Union contract restrictions.
Greater emphasis on transferrable skills.	1. Identifying skills and proficiency levels. 2. Developing assessment means. 3. Guaranteeing student proficiency.

Appendix O

Possible Actions-Options List

Knowledge/Data Base

Possible actions-options placed in the group included:

K1. Development of a centralized data capability accessible by members of the campus community.

K2. Increased electronic media data storage capability - centralized or in dedicated locations.

K3. Promote the use of electronic knowledge/data base in all classes at Northern Maine Technical College.

Communications

Possible actions-options listed in this group included the following :

C1. Installing campus wide fiber optic communications backbone.

C2. Insuring all staff have on-line access to internal and external resources.

C3. Adding external dial-up capability to enable faculty to do research and other work from off-campus locations.

C4. Actively participating in the local and statewide communication consortia currently in the planning stages.

C5. Developing distance learning delivery capability.

C6. Promoting Internet use in regular classroom activities.

C7. Insuring faculty have up-to-date equipment by establishing an ongoing capital expenditure and amortization program for equipment.

C8. Establishing a V.P. level position to be responsible for educational technology decisions and directions.

C9. Purchasing portable multimedia equipment carts.

C10. Establishing a central multimedia data storage area accessible via campus fiber optic link from any classroom or office.

C11. Increasing the number of computer networks within classrooms and labs.

C12. Promoting student purchase of their own laptops and provide convenient network connections in the classroom or elsewhere.

C13. Promoting electronic communications as the preferred method of internal communication.

Learning Management

Possible actions-options presented listed included the following:

L1. Faculty utilize multimedia to supplement and enhance current teaching methods.

L2. Develop an individualized, self-paced, open-entry open-exit learning environment.

L3. Interactive multimedia in routine use by faculty and students in the learning environment.

L4. Faculty role change from sage on stage to guide on the side.

L5. Faculty utilize course authoring software to produce interactive multimedia learning experiences.

L6. Faculty use interactive multimedia capabilities to develop student outcomes assessment.

L7. Train faculty in the use of multimedia technology.

L8. Employ the computer for all classroom administrative needs.

Appendix P

Letter to Expert Review Panel

August 18. 1995

Dear -------

As we discussed last spring, I am enclosing the first draft plan for the integration of multimedia into the learning environment at NMTC. Your review and assessment of the material included in this draft will do much to assist NMTC to be on the cutting edge of developing the technology-based learning environment of the future.

This report provides a synopsis of the research questions answered as part of the project and explains the development process to this point. Initially, it was planned to just focus on the learning management aspect of the technology-based learning model, but it quickly became clear that all three parts of the model are inextricably linked and need to be included in any plan of development.

The goals and obectives are listed in priority order based on the initial input of the NMTC management team. If you differ with the priorities set please renumber the items as you see fit. Methodologies and evaluation means have also been listed along with space for your comments and added suggestions.

Following you review of this plan please feel free to make comments on the plan itself or summarize them in you return letter. Please return the package and your comments to me at: **P.O. Box 89, Portage, ME 04768**. Thank you for taking the time to provide this valuable input into our planning process.

Sincerely,

Terrence H. Overlock, Sr.

Appendix Q

Leadership Response to Plan

NMTC
Office of the President

Northern Maine Technical College
33 Edgemont Drive
Presque Isle, Maine 04769
207.768.2806
FAX 207.768.2813

TO: Terry Overlock DRH

FROM: Durward R. Huffman, President

DATE: October 31, 1995

RE: A Multi Year Plan for the Integration of Multimedia into the Learning Environment at NMTC

On behalf of the management team, thank you for the extensive work which you have done in identifying the appropriate research questions, conducting the literature review, conducting the internal audit of multimedia capability, conducting the external audit and developing a multi year plan for multimedia use at NMTC. The work which you have done can be most valuable to Northern Maine Technical College as we continue our journey "toward excellence" in the use of multimedia to enhance the learning environment.

Appendix R

Multiyear Plan For The Integration of Multimedia Into The Learning Environment At Northern Maine Technical College

This plan is subdivided into the three major aspects of the technology-based teaching paradigm previously described. Each action-option is accompanied by (a) a major goal, (b) one or more objectives, (c) suggested methods to accomplish each, and (d) evaluation methods to determine goal and objective attainment.

Knowledge-Data Base

1. Preferred action-option K3 - Promote the use of electronic knowledge-data bases in all classes.

Goal: All NMTC faculty and students will routinely utilize available electronic knowledge-databases in their classes.

Objective 1. The library will annually provide a listing of electronic data base resources available to the campus community.

Methodology: Library Personnel will provide short training sessions for faculty and students each semester.

Methodology: Library personnel will produce a brochure listing available electronic database resources in the library.

Methodology: A quarterly newsletter from the library providing updates.

Evaluation: Maintain record of training sessions

Maintain record of publications done by library

Evaluation: Keep a log of how many use the training they have received.

Oversite Responsibility: ______________________________

Budget Allocation: __________________________________

Objective 2. By September 1998, all NMTC faculty will include a list of electronic database resources in their respective course syllabi.

Methodology: Guidelines for course syllabi will describe the necessary inclusions for adequate student information.

Methodology: Develop a homepage where all course syllabi can be by students via computer.

Evaluation: All course syllabi reviewed for listing of electronic data resources available.

Evaluation: Feedback from students concerning the degree to which they are asked to use data resources in their course work.

2. Preferred action-option K1 - Development of a centralized data capability accessible by all members of the campus community.

Goal: NMTC will implement a centralized electronic database resource with on-line access available to all of the campus community.

Objective 1. By 2000, a relational database management information system will be used to give the college the ability to generate readily available institutional effectiveness and student outcomes assessment data.

Methodology: Provide on-going training in the use of the current central computer information system.

Methodology: Hire a Management Information Systems trained person to develop the framework for such a system.

Methodology: Review current capacity and that desired for the future and prepare upgrade plan.

Evaluation: Increased daily use of central information system.
MIS person hired.
System expansion and upgrade completed.

Oversite Responsibility:____________________

Budget Allocation: ________________________

Objective 2. By fall 1998, on-line access to budget and planning information will be readily available to facilitate monitoring of spending.

Methodology: Departmental budget information organized for easy access and review on-line.

Methodology: Establish a data base for all departmental and institutional planning information.

Methodology: Staff trained in procedure to access data on-line by computer system personnel.

Methodology: Create an electronic suggestion box for ways to improve the budget, planning, and revenue generation process with ready access to all staff.

Evaluation: Current budget and planning data accessible on-line and used regularly by staff.

Oversite Responsibility: ________________________

Budget Allocation: ____________________________

Objective 3. By fall 1998, faculty, counselors, and administrators will have on-line access to student data, including assessment scores, programs of study, degree audits, GPA's and schedules.

Methodology: Responsible departments insure data is maintained and current.

Methodology: On-going training on procedures to access data provided each semester by computer personnel.

Methodology: Enable faculty to post formative assessment information in database for use by student services and advisors.

Evaluation: Student surveys and course evaluations reflect increased student satisfaction.

Increased retention of students.

Oversite Responsibility: ________________________

Budget Allocation: ___________________________

Objective 4. By fall 1998, administrators, faculty, and department chairs will work on-line to develop the course schedule each semester.

Methodology: Software and data base placed on-line and training in its use provided by inhouse or outside expert.

Evaluation: Faster scheduling with fewer conflicts.

Survey of faculty opinion regarding schedule.

Oversite Responsibility: ______________________

Budget Allocation: ________________________

Objective 5. By fall 1998, on-line course registration will maximize efficiency in registering students and on-line billing.

Methodology: On-line registration system planned and implemented by student services.

Methodology: Touch sensitive kiosks purchased for student self-enrollment.

Methodology: Faculty advisors and students given on-going training in using the on-line registration system.

Evaluation: On-line registration implemented

Registration completed with fewer conflicts.

Communications

1. Preferred option-action C6 - Promote regular use of internet resources in classroom activities.

Goal: Internet resources will be made readily available and used regularly in the learning environment at NTMC.

Objective 1. By fall 1998, 75% faculty will have ready access to the internet from their office, department, computer center, or library.

Methodology: Continue the development of the central communications infrastructure.

Methodology: Provide faculty with necessary computer equipment.

Methodology: Plan for and make available adequate technical services.

Evaluation: Inventory faculty internet access.

Survey faculty for internet use in course work.

Oversite Responsibility: ________________________

Budget Allocation: ____________________________

Objective 2. By fall 1998, 100% of NMTC faculty will be trained in the use of available internet resources.

Methodology: Provide short term training for faculty through the Continuing Education Office.

Methodology: Form faculty mentoring group to provide for continual training and support.

Methodology: All faculty maintain membership in at least one listserve.

Evaluation: Survey faculty for internet use.

Oversite Responsibility: ____________________

Budget Allocation: ________________________

Objective 3. By fall 1998, all incoming freshmen students will receive internet training by the end of their first semester.

Methodology: Continue the three day introductory training sessions currently given.

Methodology: Train other faculty to provide introductory training sessions.

Methodology: Special seminars on latest changes in technology.

Evaluation: All freshmen receive internet training by end of first semester.

Evaluation: Freshmen are required to use the internet to research a topic as part of paper in English Composition Courses.

Oversite Responsibility: _______________________

Budget Allocation: ______________________________

Objective 4. By fall 1999, 75% of NMTC course syllabi will have at least one activity requiring students to conduct research via the internet.

Methodology: Form faculty mentoring group to assess resources available and how to utilize them in the learning environment.

Evaluation: Review of course syllabi to assess internet use.

Evaluation: Student course evaluations.

Oversite Responsibility: _______________________

Budget Allocation: ____________________________

Objective 5. By fall 1998, 100% of NMTC faculty will be members of at least one listserve via the internet.

Methodology: Provide faculty with a list of academic listserves and the directions to subscribe to each.

Evaluation: Survey of faculty to determine their listserve involvement.

Evaluation: Faculty submit a short article in the college newsletter about their use of a particular listserve.

Oversite Responsibility: _______________________

Budget Allocation: ____________________________

2. Preferred option-action C1 - Install campus-wide fiber optics communications infrastructure.

Goal: NMTC's entire campus community will be connected to a campus-wide network accessible from internal and external locations.

Objective 1. By fall 1999, 100% of NMTC faculty and staff will be connected to the central communications infrastructure via fiber optic link.

Methodology: Develop plans for linkage of entire campus with regular general budget funding.

Methodology: Continue to explore alternative funding mean to speed plan completion.

Evaluation: Final plan developed - Funding sources identified.

Oversite Responsibility: ______________________

Budget Allocation: ________________________

Objective 2. By fall 1999, 75% of all campus classrooms will be connected to the central communications infrastructure.

Methodology: Include classroom linkages in the overall campus communications plan.

Evaluation: Inventory of classrooms with central communications access.

Oversite Responsibility: ____________________

Budget Allocation: ______________________

Objective 3. By fall 1999, one additional technical support person will be hired.

Methodology: Identify funding for additional technical support.

Methodology: Utilize part time contract help from the student body to assist in meeting the technical needs of faculty.

Evaluation: Survey faculty concerning level of technical support services needed and received.

Oversite Responsibility: ____________________

Budget Allocation:______________________

3. Preferred option-action C2 - all staff have on-line access to internal and external resources.

Goal: All members of the NMTC community will have on-line access to internal and external electronic data sources readily available from their office, department or other convenient location whether internal or external to the campus.

Objective 1. By fall 1999, all faculty will have on-line access readily available from their office, department or other convenient location.

Methodology: Insure all faculty have up-to-date equipment and training in its use.

Methodology: Provide for dial-up services allowing faculty and student access to the central system from off-campus locations.

Evaluation: Annual review of faculty equipment available.
Dial-up equipment installed.

Faculty training completed.

Evaluation: Assess how often faculty utilize internal and external data and communication resources.

Oversite Responsibility: ____________________

Budget Allocation: ________________________

Objective 2. By fall 1999, all students will have readily available on-line access from multiple campus locations.

Methodology: Increase the number of locations available for student on-line communications.

Methodology: Provide an increased number of open network connections that students can connect laptop commuters.

Methodology: Make dial-up services available for student use.

Evaluation: Inventory on-line access available to students.

Evaluation: Survey students concerning the availability and/or access to data ports on campus.

Oversite Responsibility: ____________________

Budget Allocation: ________________________

4. Preferred option-action C7 - Insure faculty have up-to-date communications technology by establishing an ongoing capital

expenditure and amortization program for multimedia and computer equipment at NMTC.

Goal: All faculty and students will have ready access to the latest multimedia computer equipment and software.

Objective 1. By fall 2000, NMTC will implement a 3 - 5 year computer replacement/up-grade schedule for all faculty computers.

Methodology: The academic dean's office in partnership with the business office will develop a priority listing of equipment that should be included in a 3 - 5 year plan for the amortization and replacement of equipment.

Evaluation: Faculty equipment survey reveals no equipment more than 3 - 5 years old.

Oversite Responsibility: ______________________

Budget Allocation: __________________________

Objective 2. By fall 2000, NMTC will implement a 3 - 5 year computer equipment replacement/up-grade schedule for all student classroom computer networks.

Methodology: The business department chair working with the academic deans office will develop a 3 - 5 year upgrade plan.

Evaluation: Equipment inventory shows classroom equipment to be less than 3 - 5 years old.

Oversite Responsibility: ____________________

Budget Allocation: ______________________

Objective 3. NMTC will annually conduct extensive search for alternative funding resources to supplement replacement schedule.

Methodology: The college development office will keep all personnel informed of potential grant writing and other alternative funding opportunities.

BIOGRAPHICAL SKETCH OF STUDENT

Terrence H. Overlock, Sr. is currently employed at Northern Maine Technical College (NMTC) as an instructor of math, science, and electronics. He has been at NMTC for 12 years during which time he has taught courses in physics, digital electronics, schematic reading, and math. Currently he is striving to incorporate the latest in information technology into the learning experience for these courses.

Service to the institution is provided through his active involvement in the committee structure of the campus. He has served on the curriculum and professional development committees, both of which he chaired for a time. Currently he serves on the campus strategic planning committee and fills other ad hoc committee responsibilities when asked.

He assumed leadership of campus professional development activities as director of the Title III Professional Development Program from 1992 to 1994. This program funded and tracked all campus professional development activities with an annual budget in excess of $150,000. In 1991 he led the development of a local chapter of Phi Theta Kappa student academic honor society and continues to be coadvisor to the organization. In 1993 he was certified by Phi Theta Kappa to instruct the leadership development program and continues to work to implement the program at NMTC.

Prior to his employment at NMTC he served as a teacher of math and science in the Ashland, Maine school system for 14 years. He also served with the United States Air Force from 1969 to 1973 during which time he worked as a medical instructor. While on active duty he was instructor of the month twice and achieved a master instructor ranking. He has also had varied industrial experience as carpenter, licensed electrician, plumber, bowling machine mechanic, and several other vocational related experiences all of which have fanned his interest in vocational, technical, occupational education.

Signature Sheet for the MARP Report

As a student in the Programs for Higher Education of Nova Southeastern University, I Terrence H. Overlock, Sr. give permission for the University to distribute copies of this major applied research project on request from interested parties. It is my understanding that there will be no charge for this dissemination other than to cover costs of duplicating, handling, and mailing of the materials.

____________________	____________________
(date)	(student)

I certify that I have read and am willing to sponsor this major applied research project submitted by Terrence H. Overlock, Sr.. In my opinion it conforms to acceptable standards and is fully adequate in scope and quality as a major applied research project for the degree of Doctor of Education at Nova Southeastern University.

____________________	____________________
(date)	Warren H. Groff, EdD MARP Advisor

I certify that I have read this major applied research project and in my opinion it conforms to acceptable standards and is fully adequate in scope and quality as a major applied research project for the degree of Doctor of Education at Nova Southeastern University.

____________________	____________________
(date)	Marian Gibney, EdD Local Committee Member

This major applied research project was submitted to the Central Staff of the Programs for Higher Education of Nova Southeastern University and is acceptable as partial fulfillment of the requirements for the degree of Doctor of Education.

____________________	____________________
(date)	John A. Kaufhold, EdD Central Staff Committee Member